

CANADA

REPORT OF THE MINISTER OF PUBLIC WORKS

REPORTS

OF THE

INTERNATIONAL WATERWAYS COMMISSION

1906

*Submitted in Accordance with the Provisions of Chapter 36, Section 37,
of the Revised Statutes of Canada.*

VOL. II

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1907

*To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey,
G.C.M.G., &c., &c., Governor General of Canada.*

MY LORD,

I have the honour to lay before Your Excellency the Second Volume of the Report of the Department of Public Works of Canada, for the Fiscal Year ended June 30, 1906, containing the compiled reports of the International Waterways Commission to January 4, 1907.

I have the honour to be,

My Lord,

Your Excellency's most obedient servant,

SYDNEY FISHER,
Acting Minister of Public Works.

OTTAWA, January 28, 1907.

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FIRST PROGRESS REPORT
OF THE
CANADIAN MEMBERS
OF THE
INTERNATIONAL WATERWAYS COMMISSION,
1905

INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF CANADIAN SECTION,
OTTAWA, December 24, 1905.

SIR,—The Canadian section of the International Waterways Commission has the honour to submit the following progress report.

The River and Harbour Act, passed by the United States Congress and approved June 13, 1902, contained the following provision, viz.:—

‘The President of the United States is hereby requested to invite the government of Great Britain to join in the formation of an international commission, to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, including all of the waters of the lakes and rivers whose natural outlet is by the River Saint Lawrence to the Atlantic ocean, also upon the maintenance and regulation of suitable levels, and also upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation by reason of the diversion of these waters from or change in their natural flow; and, further, to report upon the necessary measures to regulate such diversion, and to make such recommendations for improvements and regulations as shall best subserve the interests of navigation in said waters. * The said Commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof. The President, in selecting the three members of said commission who shall represent the United States, is authorized to appoint one officer of the Corps of Engineers of the United States Army, one civil engineer well versed in the hydraulics of the Great Lakes, and one lawyer of experience in questions of international and riparian law, and said commission shall be authorized to employ such persons as it may deem needful in the performance of the duties hereby imposed; and for the purpose of paying the expenses and salaries of said commission, the Secretary of War is authorized to expend from the amounts heretofore appropriated for the Saint Marys river at the falls the sum of twenty thousand dollars, or so much thereof as may be necessary to pay that portion of the expenses of said commission chargeable to the United States.’

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The invitation authorized by this section was duly communicated to the government of Great Britain by Honourable Jos. H. Choate, then American Ambassador in London, by a letter dated July 15, 1902 (copy appended, marked 'A').

On December 2, 1902, the invitation was transmitted by the Colonial Office in London to Lord Minto by a despatch dated December 2, 1902 (copy appended, marked 'B'), and by a subsequent letter dated December 3, 1902 (copy appended, marked 'C').

The Canadian government accepted the invitation of the United States government under the recommendation of the Honourable the Minister of the Interior (copy appended, marked 'D').

On June 6, 1903, the Canadian government was informed by the Secretary of State for the Colonies that His Majesty's government had accepted the suggestion of the Canadian ministers in regard to the appointment of the Canadian Commissioners (copy of Mr. Chamberlain's letter appended, marked 'E').

The American members of the commission were appointed October 2, 1903. They were Colonel O. H. Ernst, Corps of Engineers, United States Army; Mr. George Clinton, attorney-at-law, of Buffalo, N.Y.; and Professor Gardner S. Williams, of Ithaca, N.Y.

The first appointed on the Canadian section was Dr. W. F. King, Dominion Chief Astronomer, of Ottawa, on December 3, 1903 (copy of order in council appended, marked 'F'). The two other Commissioners, Mr. James Pitt Mabee, K.C., of Toronto, and Mr. Louis Coste, C.E., of Ottawa, were appointed on January 7, 1905 (copy of order in council appended, marked 'G'). On February 20, 1905, Mr. Thomas Côté, of the city of Montreal, was appointed secretary of the Canadian section of the commission. He acted as secretary of the full commission up to the appointment by the United States government of Mr. L. C. Sabin, as secretary of the American section, on August 1, 1905. On May 20, 1905, Mr. James P. Mabee was appointed president of the Canadian section of the commission (copy of order in council appended, marked 'I').

The Canadian section held its first meetings in Ottawa, Ont., on March 6 and 7, 1905. The scope of the investigations to be undertaken was defined in a letter addressed to each Commissioner by the Honourable the Secretary of State for Canada, dated January 16, 1905 (copy appended, marked 'J'), from which the following is an extract:—

'Among the subjects that may come up for consideration before this commission are:

'1. The proposed diversion southward by the Minnesota Canal and Power Company, of Duluth, of certain waters in the state of Minnesota that now flow north into the Rainy river and the Lake of the Woods.

'2. The diversion about a mile and a half east of the town of Sault Ste. Marie of part of the waters of the St. Marys river into the Hay channel entirely through American territory. The River St. Marys now forms part of the boundary between the United States and Canada, and the waters of the river are clearly international. The Canadian vessels of necessity are using the Hay channel, but no treaty has been made concerning their right.

'3. Inquiry into the effect of the levels of Lakes Huron and Erie by the construction of the Chicago Drainage Canal.

'4. The building of a dam and other obstructions on the St. John river flowing through the state of Maine into New Brunswick, contrary to the express stipulation of the Ashburton treaty.'

The American section held its first meeting in Washington, D.C., on May 10, 1905, and organized by the election of Colonel Ernst as chairman. The scope of the investigations to be undertaken was defined in a letter from the Department of State, dated April 15, 1905 (copy appended, marked 'K'), from which the following is an extract:—

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'The wording of the law will be seen by reference to the inclosed copy. The department's opinion is that the words "including all of the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean" are intended as a limitation on what precedes them, and that the investigation and report should cover only such waters, omitting the lower St. Lawrence itself, as well as all other waters not discharging naturally through it.

'The broader interpretation given to the Act by the Canadian authorities should be rejected, if for no other reason, on account of the smallness of the appropriation for the support of the American section. Congress could hardly have intended to provide, with a sum of \$20,000, for the expenses incident to an investigation extending to the Pacific coast, and possibly embracing the Alaskan boundary as well.'

Previous to the first meeting of the American section, it was learned that the United States government had placed upon the Act of Congress, authorizing the appointment of the commission, a construction limiting considerably the scope of the investigations to be undertaken.

By a despatch dated February 3, 1905 (copy appended, marked 'L'), the Canadian government, through diplomatic channels, made representations to Washington in regard to the erection of further piers in the St. John river. On February 24 the United States Secretary of State informed the Canadian government, through His Majesty's Ambassador in Washington, Sir H. M. Durand (copy of Sir H. M. Durand's despatch and copy of Mr. John Hay's letter appended, marked 'M' and 'N,' respectively), that the commission was debarred from investigating the case of the St. John river and making a report thereon.

On March 25, 1905, the Canadian government made further representations to the United States government (copy of order in council appended, marked 'O'), from which the following is an extract:—

'The minister further observes that throughout the correspondence which has taken place prior to the appointment of the Canadian section of the commission, the terms used have always been identical to those of the Act above referred to (the River and Harbour Act approved June 13, 1902), and that it has always been understood that the investigation would bear upon the conditions and uses of the waters adjacent to the boundary line between Canada and the United States, the other waters belonging to the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean being stated to be also included therein, but the general scope of the commission being especially intended to apply to all waters adjacent to the boundary line between Canada and the United States.

'The minister, therefore, is of the opinion that in the despatch under his consideration an unintentional misapprehension has existed as regards the terms of the Act of Congress, and that it is fit and proper that the work of the commission be not restricted to narrower limits than those indicated by the said Act.

'The minister, therefore, recommends that the necessary representations be made in order that the investigation to be carried on by the said commission, and the report to be based thereon shall extend to all the waters adjacent to the boundary line between Canada and the United States, and, therefore, include such portions of the St. John river as will come within the limit assigned by the Act of Congress to the work of the commission.'

In the meantime, the American section at its meeting, held on May 10, had decided to invite the Canadian members to join in the first full meeting of the commission in Washington, D.C., to be held May 25, and an invitation was issued accordingly by the Department of State at the request of the Secretary of War. On May 25 the full commission held its first meeting in Washington and organized by the election of Colonel Ernst as chairman of that meeting, it being agreed that at meetings of the full commission held on American territory, the chairman of the American section should preside, and at meetings held on Canadian territory, the chairman of the Canadian

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section should preside. The Canadian members paid a visit of courtesy to President Roosevelt, where the scope of the investigations was informally discussed. The full commission also proceeded in a body to call upon the Secretary of State.

The commission remained in session during the 25th and the following day, discussing the organization, permanent places of meeting, and scope of their duties. It was decided that for the present the offices of the Canadian section should be established in Toronto, and those of the American section in Buffalo, and that full meetings should be held in one or the other city, as should be found most convenient. Subsequently, though, the Canadian section decided to establish its permanent quarters in the city of Ottawa, not having been able to find in Toronto, at any reasonable price, suitable offices.

The American section having presented the instructions under which they were acting, quoted above, the president of the Canadian section, Mr. J. P. Mabee, presented the following memorandum :—

‘The Canadian members of the International Waterways Commission had understood the scope of the commission to be wider than the American members regard it, and that misunderstanding may be avoided, desire briefly to state the position they have understood matters to be in.

‘The invitation of His Majesty’s government, through the American Ambassador in London, was “for the appointment of an international commission, to be composed of three members from the United States and three who shall represent the Dominion of Canada, whose duty it shall be to investigate in general the waters adjacent to the boundary line between the United States and Canada, the effect upon the shores produced by changes in the water levels, and the erection and location of a dam at the outlet of Lake Erie.”

‘In due course by a report of the Committee of the Privy Council of Canada, approved by the Governor General of Canada, it was resolved “that His Majesty’s government accept the invitation to co-operate in the formation of the commission,” this report, after further reciting that as the subjects to be dealt with pertained to “the regulations of the waters adjacent to the international boundary,” the matter in so far as Canada was concerned should be under the Department of the Interior and the Department of Public Works.

Some regrettable but unavoidable delay in completing the Canadian section of the commission arose by the long-continued illness of the Honourable the Minister of Public Works for Canada.

In the despatch to the government of Great Britain, naming the American Commissioners, the invitation to His Majesty’s government is again recited as being one to form an “international commission to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada.”

‘After the appointment of the Canadian Commissioners, the Prime Minister of Canada, Sir Wilfrid Laurier, in communicating the matter to the Canadian House of Commons in January last, dealt with the subject-matter of the commission as covering all waters adjacent to the boundaries of the two countries, and in the course of his speech made the following statements: “In sections of the country where the boundary is not water, but land, there are streams and large rivers which have their sources in one country and which flow into another. Complaint has been made by the United States that Canadians have constructed some works upon rivers which have their sources in Canada and which flow into the United States, and that these works affect the flow of the waters in their country. We also have made complaints to the United States that Americans have constructed upon some rivers, the St. John river, for instance, works which affect the flow of the waters in our country. It is, therefore, to the mutual interest and advantage of both countries to have this question properly investigated with the view of having concurrent legislation, if such should be found necessary. From olden times it has been a principle of Roman law, which has been

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adopted by most civilized nations, that the riparian owner of any stream has the right to use the water of that stream for his own benefit, provided he does not impair the flow of the water beyond the boundary of his property. This is a principle of law which dominates in almost every country; but it is not possible to have this principle followed and carried out when the works are in one country and the boundary of the property is in another country. For these reasons we have thought it advisable to respond to the invitation of the United States to have this question investigated. We have agreed to a commission, to be composed of six members, three to represent the government of the United States and three to represent the government of Canada."

'If the inquiries of the commission are to be limited to the waters of the Great Lakes only, it would seem that the government of Canada has been under a misapprehension as to the desires and intentions of the government of the United States, and we regard it as our duty to report to our government the limitations expected to be placed upon the scope of the commission, and we respectfully suggest that further action should be delayed until we may be advised of the views of the government of Canada upon the premises.'

This was concurred in by the two other Commissioners, Dr. W. F. King and Mr. Louis Coste.

The chairman of the American section stated that he was informed that the British government had communicated with the American government, through diplomatic channels, requesting that a broader interpretation be given to the Act of Congress providing for the commission, and that the American government then had the matter under consideration, but that no decision could be taken before the return to Washington of the United States Secretary of War, at the time absent in the state of Ohio. It was then decided that further proceedings be deferred until further instructions be received from the two governments. It was agreed that the decision of the American government should be communicated to the chairman of the Canadian section as soon as received, and that if it be favourable to the Canadian interpretation of the law, or if it be unfavourable and be accepted by the Canadian government, then a meeting of the commission should be called on Canadian territory by the chairman of the Canadian section at as early a date as practicable. The result of this meeting was communicated to His Majesty's Ambassador at Washington by the secretary of the Canadian section, and Sir H. M. Durand and Mr. H. O'Beirne, the British charge d'affaires, had interviews with Secretary of War Taft and Acting Secretary of State F. B. Loomis, urging the contention of the Canadian government as set forth in the order in council of March 25, 1905, above quoted and appended, marked 'O.'

The United States government persisted in its interpretation of the Act of Congress, and His Majesty's Ambassador in Washington was so informed by the Acting Secretary of State, F. B. Loomis, in a letter dated May 31, 1905 (copy appended, marked 'P').

On June 2, the Acting Minister of Public Works, Honourable W. S. Fielding, was informed by the secretary of the Canadian section of what had happened in Washington (copy of the memorandum appended, marked 'Q').

On June 5, 1905, the following instructions were given to the Canadian section by the Right Honourable Sir Wilfrid Laurier:—

PRIME MINISTER'S OFFICE, CANADA,

'OTTAWA, June 5, 1905.

'DEAR SIR,—With reference to the objection raised by the American Commissioners to consider any other waters than the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean, it would be of no use to persist in our contention, and the government, therefore, are of opinion that the Commissioners had better proceed even in this limited way.

'At the same time, the Canadian Commissioners would do well to call the atten-

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tion of the commission to the condition of things which exists on the River St. John, and the necessity of prompt joint action thereon.

‘Yours very sincerely,

WILFRID LAURIER.

‘THOMAS CÔTÉ, Esq.,

‘Secretary, Canadian Section,

‘International Waterways Commission,

‘Ottawa.’

In the meantime, the decision of the United States government had been communicated to the president of the Canadian section by a letter dated June 2, 1905 (copy appended, marked ‘R’). The chairman of the Canadian section communicated to the chairman of the American section the decision of the Canadian government, authorizing the Canadian members to proceed with the work of the commission within the field prescribed to the American members (see letter copy appended, marked ‘S’).

The Canadian section then proceeded to complete its organization. Through the courtesy of the Honourable the Minister of Public Works, temporary quarters in the Seybold building, in Ottawa, were assigned to its use, and later on, excellent quarters were procured in the Corry building. The American section, on the other hand, proceeded also to complete its organization, establishing its quarters in the Federal building in Buffalo. Mr. L. C. Sabin, the secretary of that section, took charge of the office on September 11, 1905.

The full commission held its second meeting at Toronto, June 14 and 15, 1905. It was learned then that Professor Williams had tendered his resignation as member of the commission, and had been replaced by Mr. George Y. Wisner, C.E., of Detroit, appointed June 8, 1905. Among the questions brought to the attention of the commission at this meeting were the following, viz.:—

‘A. The uses of the waters at Sault Ste. Marie for power purposes, and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of the navigation interests.

‘B. The uses of the waters of the Niagara river for power purposes, and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of Niagara falls as a scenic spectacle.

‘C. The alleged differences in the marine regulations of the two countries with respect to signal lights, and the advisability of adopting uniform signals for both countries.

‘D. The advisability of building controlling works at the outlet of Lake Erie, including the effect upon the levels of the lakes and upon their shores, and upon the River St. Lawrence.

‘E. The diversion southward by the Minnesota Canal and Power Company, of Duluth, of certain waters in the state of Minnesota that now flow north into the Rainy river and the Lake of the Woods.

‘F. The effect of the Chicago Drainage Canal upon the levels of Lakes Michigan, Huron, Erie and Ontario, and upon the River St. Lawrence.

‘G. Delimiting the international boundary on the international waterways and delineating the same on modern charts.

‘H. The suppression or abatement of illegal fishing on the Great Lakes.

‘I. The location and construction of common channels.

‘J. Regulations to govern navigation in narrow channels.

‘K. Protection of shores from damage due to deepening of channels and increased speed.

‘L. The transmission of electric energy generated in Canada, to the United States, and vice versa.’

The questions more specially dealt with at the meetings of the commission, on June 14 and 15, in Toronto, were the construction of regulating works at the outlet of Lake Erie, and their probable effect on Lake Ontario and on the River St. Lawrence;

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the uses of the waters of Niagara river for power purposes, and the preservation of the falls; and the proposed works of the Minnesota Canal and Power Company, which were referred to the committee on jurisdiction, composed of the attorneys of the two sections, and also to the engineering committee, composed of Messrs. Gorge Y. Wisner and Louis Coste.

In view of permitting the commission to make its existence known to the persons most interested in the international waterways, so as to receive suggestions from them, and to visit in person some or all of the principal localities concerned, it was decided to give public hearings where such hearings were desired by the local business interests.

On July 7, the commission in a body paid a visit of courtesy to the Canadian government, at Ottawa, and were the recipients of many delicate attentions from the authorities. Between July 9 and 13, the commission passed over the St. Lawrence river and the Canadian canals from Quebec to Kingston, using the government steamer *Frontenac*, kindly placed at their disposal by the Honourable the Minister of Marine and Fisheries. Public hearings were held at Montreal July 11, at Kingston July 13, at Niagara Falls September 14, at Toronto September 15, at Hamilton September 16, and at Buffalo November 10. At the first hearing in Montreal, strong objections were presented by the commercial and shipping interests against the proposed construction of controlling works at the outlet of Lake Erie, in fear that such works would be detrimental to the navigation of the St. Lawrence river, and more especially to the St. Lawrence ship channel from Montreal to Quebec. It was then emphatically stated by the American members of the commission that no plan had yet been prepared for the proposed works, and if said works were to cause injury to the River St. Lawrence, the proposition would be entirely and absolutely rejected.

The same expression of opinion was given at the public hearings held in Kingston, Toronto, Hamilton and Niagara Falls.

During the month of August a majority of the members of the commission visited the Detroit river, the St. Clair river, Lakes St. Clair and Huron; St. Marys river, Sault Ste. Marie; Lake Superior; Port Arthur, Fort William and their surroundings; Duluth, Minneapolis, St. Paul, Chicago and Detroit. The report of the sub-committee who made this investigating trip is appended, marked 'Z.'

Meetings of the full commission were also held at Buffalo on September 11, 12 and 13, October 27 and 28, and November 10 and 11. To enable all interested persons to appear before the commission, or to address it, it was arranged that public notice of all meetings would be given as long in advance as possible through the press of the principal cities on both sides of the Great Lakes and the St. Lawrence river.

SAULT STE. MARIE.

Of all the questions brought to the attention of the commission the most pressing one for consideration was that relating to the uses of water at the Sault Ste. Marie. The situation there, in brief, as described in the progress report of the American section of the commission to the United States Secretary of War is this:—

'The volume of water flowing out of Lake Superior is, at normal low water—elevation 601—about 64,000 cubic feet per second. Lower stages and a lower discharge have sometimes occurred. On either side of the rapids is a navigation canal, constructed by the United States and Canadian governments, respectively.

'The traffic through these canals has reached enormous proportions and is increasing. It is larger this year than ever before, and will greatly exceed 40,000,000 tons for the year. The quantity of water consumed in the operation is about 1,200 cubic feet per second. The quantity required in the future will be greater. Not less than 4,000 cubic feet should be unconditionally reserved for canal uses, and in granting power privileges, the respective governments should not forfeit the right to increase the amount indefinitely. It may be remarked in passing that raft navigation over the

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rapids has so greatly diminished, and is now so small in amount, that the quantities of water above mentioned will suffice to provide for it. This leaves about 60,000 cubic feet which may be temporarily used for power purposes.

'On the Canadian side the Lake Superior Power Company has a power canal in operation, which has a capacity of about 9,000, and is using about 7,000 cubic feet per second. This company has designed an additional canal, not yet constructed, which will have a capacity of about 23,000 cubic feet per second. On the American side the Michigan Lake Superior Power Company has in operation a power canal, which has a capacity of about 31,000, and is using about 3,500 cubic feet per second. This canal takes the water from the St. Marys river above the rapids, conducts it through the city of Sault Ste. Marie, and empties it about a mile below the rapids. On the American side also the Chandler-Dunbar Company, owning a portion of the shore line adjoining the rapids, have in operation power works using about 1,400 cubic feet per second. This company is engaged in altering and improving its works in the bed of the stream, under revocable permits from the department.

'Under permits thus far granted, the consumption of water will be increased to about 3,000 cubic feet per second, but in March, 1902, the company applied for a permit to build a dike downstream from the fourth pier, counting from the American side of the International bridge in a direction nearly parallel with the shore, to connect with a power house extending out an equal distance into the stream. A rival company, the St. Marys Power Company, applied in March, 1903, for permission to construct a power canal by means of two parallel dikes extending downstream and a short distance upstream, from the third and fifth piers of the bridge, with corresponding power-house. Neither of these latter requests were granted, but they show what the intentions of the companies are, if they be permitted to carry them out. Evidently there is not enough water to carry out all of these schemes. An understanding must be reached by which there shall be an equitable division of the surplus water between the two sides of the boundary. The division between rival companies, fortunately for this commission, may be left to the courts of law.'

The figures above quoted for the Chandler-Dunbar Power Company represent 700 cubic feet per second being actually used, and 700 cubic feet per second being wasted.

The application to the War Department of the United States from the American companies for further privileges, and from the Lake Superior Power Company to the Canadian government for additional authority, led the commission at its session of October 28 to pass the following resolution, of which copies were sent to the Secretary of War of the United States and the Minister of Public Works for Canada, viz.:—

'Resolved, that in the opinion of this commission, no further rights or privileges should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior, by either the government of the United States or Canada, until all data and information are in the hands of the commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such rights or privileges be granted, they be subject to any regulation that may be adopted by both governments.'

This resolution was transmitted to the Lieutenant-Governor of Ontario by the Secretary of State for Canada, upon a report of the Privy Council (copy appended, marked 'T').

The use of water in St. Marys river for power purposes must be so regulated as not to affect injuriously the level of Lake Superior. The level must never be allowed to fall so low as to injure navigation, and it must never be raised so high as to submerge the shores.

The Act of Congress, approved on June 13, 1902, authorized the Michigan Lake Superior Company to divert water from St. Marys river, above the rapids, with certain conditions, which are described as follows in the Act, viz.:—

'Subject to the express precedent conditions hereinafter mentioned, the Michigan Lake Superior Power Company, of Sault Ste. Marie, Michigan, its successors and as-

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signs, after first obtaining consent of the Secretary of War and the Chief of Engineers and their approval of the said canal and remedial works proposed, is hereby authorized to divert water from the Saint Marys river into its water-power canal now being constructed at Sault Ste. Marie, Michigan, for water-power purposes while and so long as such works and diversion of water from said river shall not injuriously affect navigation therein, nor impair or diminish the water levels or any natural increase thereof either in Lake Superior or in the United States ship canal and locks or the navigable channels, locks or ship canals connected therewith, whether natural or artificial, now existing or which may hereafter be established or created by the United States for navigation purposes. And conditioned further, that said company shall establish, maintain and operate suitable and sufficient remedial and controlling works in the rapids of said river, to the approval of the Secretary of War, and the Chief of Engineers; and the said company shall maintain and operate said canal and works in accordance with any rules and regulations that may hereafter be recommended by any international commission and that shall become operative. Whenever, in the judgment of the Secretary of War, the operation of said canal and remedial and controlling works, or either of them, either in themselves or in conjunction with any other canal or canals in the United States or Canada which now or hereafter may exist, is injuriously affecting water levels or the navigation of Lake Superior, the River Saint Marys or other channels, locks or ship canals connected therewith as hereinbefore provided, he shall impose upon said company such rules and regulations for the operation of said canal and remedial works, as may, in his opinion, be necessary to prevent such injury. It shall become his duty, and he shall have the authority to enter upon the property of said company and to close said canal in whole or in part to the extent necessary to maintain water levels and to require said company, at its own expense, to remove, add to or modify said works or any part thereof to the extent necessary to maintain water levels. Neither the Secretary of War nor the Chief of Engineers or any officer or other person acting under direction of them or either of them, shall be in any way liable by reason of anything done in the execution of this provision.

‘All remedies herein provided, however, shall be cumulative, and shall be without prejudice to any other remedies, either of the United States or of individuals, for failure of said company to maintain said levels for navigation purposes as herein provided.

‘Nothing herein contained shall be held to affect any existing riparian or other rights of any person or corporation, or the existing remedies therefor, or any action at law or equity now pending. The right is hereby expressly reserved to congress to alter, amend or repeal the provisions contained in this paragraph.’

The United States War Department entered into an agreement with the Michigan Lake Superior Power Company (copy of which is appended, marked ‘U’), and imposed upon the company certain rules and regulations to govern the maintenance of the level of Lake Superior. In the legislation above quoted and in the agreement referred to, the principle was recognized that the use of the water of St. Marys river for power purposes was not granted in any fixed quantity nor for any fixed length of time. It was further recognized that the Secretary of War could enter upon the property and close the canal of the company, in whole or in part, at any time to the extent necessary to maintain the level of St. Marys river above the rapids. The Act further stated that the use of the water of St. Marys river should finally be regulated by an international commission. The rules and regulations imposed upon the Michigan Lake Superior Power Company by the Secretary of War on December 2, 1902, are still in force and will probably be used by the International Waterways Commission as a foundation in framing the regulations to be ultimately recommended to the government of Canada and to the government of the United States. The fundamental principles on which these rules and regulations are based are:—

1. Levels must be maintained.
2. Navigation must be protected.

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3. The public must reserve the right to use any portion or all of the natural flow in the future.

A public hearing, at which the parties interested in the condition of affairs at Sault Ste. Marie were given an opportunity to be heard, was held in Buffalo on November 10. The Lake Carriers' Association appeared before the commission and made a strong plea in favour of reserving the land north of the Poe lock for the construction of an additional ship canal and locks.

The commission, at its session of November 11, practically adopted certain rules and regulations to govern the use of the water at St. Marys river and the maintenance of the level of that river above the rapids, and it is hoped that said rules and regulations can be forwarded to the United States Secretary of War, and to the Minister of Public Works of Canada, for approval at an early date. The enforcement of these rules and regulations calls for executive action from time to time, and in this regard the American section of the commission, in its progress report to the Secretary of War, suggested that said executive action be vested in an international commission. Here follows the suggestion of the American section:—

‘The enforcement of these rules and regulations calls for the executive action from time to time of an international commission. The enforcement of rules to be established hereafter at other places or upon other subjects will probably likewise require joint executive action. It is not clear from the language of the law creating this commission that congress intended to provide for a permanent international board. It is desirable that the status of the present commission as a permanent executive board be defined, or a new board created.’

The questions brought to the attention of the commission enumerated above cover a wide range of subjects. Some of them clearly come under the jurisdiction of the commission as constituted and as limited in its scope by the United States government. Some do not, if the opinion of the United States Attorney General is to prevail, come under the jurisdiction of the commission, whilst about others there is room for doubt. The American section, in the progress report made to the United States War Department (copy appended, marked ‘A 1’), has suggested that the jurisdiction of the commission be more clearly defined.

The United States Secretary of War, in his annual report to President Roosevelt, dated December 9, 1905, has approved the suggestions of the American section in this regard. Here is what he states at pages 51 and 52 of said report:—

‘The full commission has held numerous meetings and public hearings, in both the United States and Canada, and has collected a large amount of data bearing upon the various questions which have been brought to its attention. A progress report, showing the work that has been accomplished, is attached hereto marked Appendix F, and attention is invited to this report for a full and detailed statement of the labours of the commission.

‘It has been hampered in its work by a lack of clear understanding as to its permanency and as to the eventual scope of its duties. For example, in making regulations for the uses of the surplus waters at the Sault Ste. Marie for power purposes, it seems necessary to provide for joint continuous supervision. The enforcement of rules to be established hereafter at other places or upon other subjects will probably likewise require joint executive action. It is not clear from the language of the law creating the commission that Congress intended to provide for a permanent international board. It is desirable that the status of the present commission as a permanent executive board be defined or a new board created.

‘The questions which have been brought to the notice of the commission by various persons or interests thus far cover a wide range of subjects. Some of these questions clearly come under the jurisdiction of the commission as constituted, while some clearly do not, and about others there is room for doubt. The Canadian members of the commission are ready and anxious to consider all of these questions and to extend the jurisdiction of the commission to all international waters between the

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Atlantic and the Pacific oceans. It is desirable that the wishes of Congress in this matter be more defined.'

Since the commission completed its organization, it has made good progress in the collection of data bearing upon some of the questions brought before them, particularly upon those relating to the uses of the waters of the Niagara river for power purposes; the regulation of the level of Lake Erie by works near its outlet, and the proposed works of the Minnesota Canal and Power Company.

NIAGARA FALLS.

With reference to the uses of the waters at Niagara Falls, although the commission was not ready to report, it thought proper to pass, at its session of October 28, the following resolution, of which copies were sent to the Secretary of War of the United States and to the Minister of Public Works of Canada, viz.—

'Resolved, that this commission recommend to the government of the United States and Canada that such steps, as they may regard as necessary, be taken to prevent any corporate rights and franchises being granted or renewed by either federal, states or provincial authority for the uses of the waters of the Niagara river for power or other purposes until this commission is able to collect information necessary to enable it to report fully upon the "condition and uses" of those waters to the respective governments of the United States and Canada.'

This resolution was transmitted by the Secretary of State for Canada to His Honour the Lieutenant-Governor of Ontario, and by the United States Secretary of War to the Governor of the State of New York.

The Canadian section requested Monseignor J. C. K. Leflamme, the eminent professor of geology at Laval University, Quebec, to make a special report on the geological condition of the bed of the river in the vicinity of the falls. His report is appended, marked 'V.'

The situation at Niagara in brief is this:—

The following quantities of water are required for chartered developments in operation or in course of construction on both sides of the river:—

On the Canadian Side—

The Ontario Power Company.. . . .	12,000	cubic feet per second.
The Electrical Development Company..	10,600	" "
The Canadian Niagara Power Company	9,500	" "
<hr/>		
Total.. . . .	32,100	

On the American Side—

The American Niagara Falls Power Co..	17,200	cubic feet per second.
The Niagara Falls Hydraulic Power and Manufacturing Company.. . . .	9,200	" "
<hr/>		
Total.. . . .	26,400	

Total on both sides, 58,500 cubic feet per second.

It is estimated that the total flow over the two falls is 222,400 cubic feet per second. There remains to be determined to what extent the use of 58,500 cubic feet per second for power purposes by the present companies, on both sides of the river, will affect the American fall. A competent hydraulic engineer, at the request of Dr. Clarke, the geologist of the State of New York, has calculated that the subtraction of 40,000 cubic feet per second from the Niagara river above Goat island will draw the water down to the rock bottom edge of the American fall, leaving a miserable little film dribbling over the sill; and that the subtraction of 40,000 cubic feet more,

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or 80,000 cubic feet per second in all above Goat island, will dry up the American channel completely, while the Canadian channel will still be an object of interest. Does this necessarily mean that the using of more water on the Canadian side, assuming that said water is taken below the crest of the rapids, will also affect the American fall? This is a point to be determined.

According to the Niagara Falls Electrical hand book, the height of the Canadian fall, over which flows about seven-eighths of the entire volume of water, is 159 feet. The height of the American fall is 165 feet, or about six feet greater than that of the Horseshoe fall, the difference in the level being caused by the greater declivity in the bed of the river in the Canadian channel.

The official geologist of the State of New York states that the height of the American fall is by ten feet greater than the Horseshoe fall. Other engineers and experts have put the difference to from twelve to fourteen feet. This point should also be determined.

The slope of the Niagara river towards the Horseshoe fall is such that the level in the vicinity of the intakes of the power plants on the American side is considerably higher than the Horseshoe fall, towards which the water flows down as in a steep recipient. The American fall is barred off on this channel by a reef near the head of Goat island. The form of the Niagara river is such, however, that it spills over the side of the draw leaving to the Horseshoe fall and branches the water which flows over the American fall. It is clear that the drawing of water from the American side must have a greater effect upon the lower end of the American fall than drawing it on the Canadian side, two of the Canadian intakes being below the crest of the rapids. The data are lacking regarding the speed of this descent, hence it is not possible to estimate with any accuracy what are the relative amounts of water which can be drawn from the two sides of the river without affecting the American fall. *En resume*, we have no absolute data to govern us at the present time.

Besides the chartered developments referred to above, there are in existence two charters granted by the New York legislature to corporations organized to take unlimited water from Niagara river.

The Dominion Parliament has also granted charters to three corporations which are still in force and organized for the purpose of diverting water from the Welland river or from the Niagara river by back flow, and from Grand river and Lake Erie.

None of these companies on either side of the river have actually commenced the construction of their works.

At Chicago, citizens of the United States have built a drainage canal, which, when fully completed, will use 10,000 cubic feet of water per second. This drainage canal will have the effect of lowering Lake Michigan by over six inches and Lake Erie by nearly four inches. It will, beyond a doubt, materially affect the flow of the Niagara river over the falls.

On the Canadian side there is also the Welland canal and the Hamilton Cataract Power Company, who take their water from the Welland canal, using the escarpment at De Cew's falls and representing a total diversion of 2,400 cubic feet per second.

There is also the Niagara Falls Park River Railway Company, who are using 1,500 cubic feet of water per second.

On the American side another diversion of 1,500 cubic feet per second is made by way of the Erie canal.

Therefore the total diversions of water by works in operation or under actual construction on the American side represent 37,900 cubic feet per second, and on the Canadian side the total quantity of water which will be ultimately diverted by works actually in operation or in way of construction represent 36,000 cubic feet per second.

President Roosevelt, in his message to congress on December 5, 1905, stated as follows:—

‘In my judgment, the Grand Canyon of the Colorado should be made into a national park. It is greatly to be wished that the state of New York should copy, as regards Niagara, what the state of California has done as regards the Yosemite.

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Nothing should be allowed to interfere with the 'preservation of Niagara falls in all their beauty and majesty. If the state cannot see to this, then it is earnestly to be wished that she should be willing to turn it over to the National government, which should in such case (if possible, in conjunction with the Canadian government) assume the burden and responsibility of preserving unharmed Niagara falls; just as it should gladly assume a similar burden and responsibility for the Yosemite national park, and as it has already assumed them for the Yellowstone national park. Adequate provision should be made by congress for the proper care and supervision of all these national parks.'

Your commission are desirous of obtaining the views of the government as to preserving the scenic beauty of Niagara falls.

No doubt the government of the province of Ontario will be ready to co-operate with the Dominion government in this regard. An agreement will have to be arranged whereby the quantity of water diverted for power or other purposes shall be limited, and there will have to be an arrangement for equitable division of such waters. The demand for use of power for commercial purposes will increase every year, and it will require a very strong stand to prevent the despoiling of this one of nature's greatest wonders.

The Federal government has, in the opinion of this commission, control of the deportation of power to the United States. Unfortunately, a very large portion of the power generated on our side of the river at Niagara will, unless some more effectual restrictions are placed upon its removal, soon be permanently diverted to the building up of American factories and the running of American railways. Within a few years our own railways will be clamoring for this power. Vested rights already interfere with action in this regard, and the more power that is now allowed to be diverted the greater will be the evil and the harder to rectify.

It is quite evident, in the view of the commission, that the jurisdiction to deal with international waters must be vested in the Federal government of each country. Changed conditions and the greatly increased demand for power, owing to electrical developments, have rendered it absolutely essential that there should be one authoritative body controlling the diversion of such waters. The interests of navigation must be paramount, and the Federal government alone must ultimately decide what those interests are. The maintenance of Niagara is a national matter, and should be dealt with on national lines.

The whole question of riparian rights in relation to navigable streams or international waters will most likely have to be adjusted by some treaty arrangement between the two countries, and instructions will have to be given to some commission to report upon some scheme of settlement upon broad lines.

It is desirable to have settled by the highest authority as soon as possible, whether the water in navigable international streams is in any sense the property of the provinces or states bounding on the same, or whether whatever property rights exist in such streams are vested in the Federal government. If it should be held that the provincial and state authorities have proprietary rights in such waters, then your commission are of the opinion that some arrangements should be made with the provinces by which such rights should be acquired, so that the use of the same may be the subject of a reasonable treaty of mutual benefit with our neighbours.

RAINY RIVER.

The proposed works of the Minnesota Canal and Power Company are of vast importance to the Rainy river district. They may be described as follows:—

At the height of land in St. Louis and Lake counties in northern Minnesota, the waters from Birch lake and White Iron lake, and the streams running out thereof, and the immense watershed thereof, run northward and ultimately into Rainy lake, and from there into Rainy river, passing into the Lake of the Woods. The water from this

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source forms by computation seven per cent of the water passing out of Rainy lake over Alberton falls at Koochiching. The water system of Rainy river and Lake of the Woods have long been established as a commercial highway. From the Canadian ports of Rat Portage and Fort Francis, two large and well equipped passenger and freight lines ply daily during the season of navigation, forming the means of water communication between the Canadian ports of Rat Portage, Rainy River town, Boucherville, Burwick, Emo, Big Forks, Little Forks, Isherwood, Fort Francis, Bears Pass, Seine River and Mine Centre, and forming along a considerable part of such route the only vehicle of passenger and freight communication.

The most important section of the two hundred miles of navigation is the Rainy river, flowing through what is rapidly becoming a thickly populated and prosperous valley for some eighty odd miles, with towns rapidly building up at close intervals on its banks dependent almost wholly on the river route for their mercantile and manufacturing interests. The fine class of steamboats plying on this water is already in certain portions of the summer hampered by low water on the rapids and shoals of the river, and the proprietors of the regular steamboat lines have been earnestly petitioning for such improvement being made on the river as would remove such disability, a disability that compels the withdrawal for considerable intervals during each summer of some of the large and deeper draught steamboats. In view of the fact that navigation is already suffering for lack of adequate water in portions of Rainy river and in portions of Rainy lake, the population of that district has learned with surprise and alarm that active steps had been taken by the Minnesota Canal and Power Company, of Duluth, Minn., to obtain the authorization of the Federal government of the United States, through the Commissioner of the General Land Office at Washington, to construct a dam or dams and a canal to divert all the waters of the Birch lake and White Iron lake watershed, hereinbefore referred to, into the Embarrass river, and by it into Lake Superior at Duluth, thus diverting from this long established international waterway of Rainy lake and Rainy river a large proportion of its tributary waters. It is claimed that, if permission be given by the Federal government of the United States to the project of the Minnesota Canal and Power Company, a disastrous injustice will be done to Canadian and American established navigation companies that are now using the water highway of Rainy lake and Rainy river, and to the manufacturing towns along the river, both on the Canadian and United States sides.

It is claimed that the waters of Birch lake and Birch river and White Iron lake help to form the chain of lakes and rivers along the boundary which are referred to in the Webster-Ashburton treaty, and which, by the terms of the treaty, are a public highway, free to the citizens and subjects of both countries. The scheme of the Minnesota Canal and Power Company is to take 600 cubic feet per second out of a total estimated average flow of 985 cubic feet per second. The minimum flow is estimated at 210 cubic feet per second. The quantity to be taken, 600 cubic feet per second, would be more than the natural flow during the greater part of the year.

The corporation of the town of Fort Francis, on March 17, 1904, sent to the Minister of Marine and Fisheries of Canada, a protest against the proposed undertaking of the Minnesota Canal and Power Company. This protest has been sent by the Canadian government to the United States government, through the British Embassy at Washington.

On January 25, 1905, the Acting Secretary of State, F. B. Loomis, informed the Right Honourable Sir H. M. Durand, the British Ambassador in Washington (copy of his letter appended, marked 'W'), that the United States Secretary of the Interior had directed the Commissioner of the General Land Office, before whom the application of the Minnesota Canal and Power Company was pending, to suspend further action in the case until advised as to the results of the inquiry which was to be made by the International Water Boundary Commission. Later on the Attorney General of the United States, called upon to give his opinion on the construction to be put upon the Act of Congress authorizing the appointment of the commission, stated in reference to the case of the St. John river, New Brunswick, that the jurisdiction of the

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commission was limited to the system of the Great Lakes and the St. Lawrence river. The members of the American section have since then felt reluctant in dealing with the question of the proposed works of the Minnesota Canal and Power Company, and they are awaiting further instructions from Congress in regard to this matter.

Since the Minnesota Canal and Power Company made this application to the United States Secretary of the Interior, the Rainy River Development Company and the Ontario and Minnesota Power Company have constructed extensive works at Koochiching falls for the purpose of improving navigation in Rainy lake and Rainy river, with the expectation of using the power which will be developed for manufacturing purposes. The Ontario and Minnesota Power Company, under a contract with the Ontario government, has acquired the Canadian end of the Koochiching falls, and a number of acres of shore land adjacent. They have obtained, during the last session of parliament, an Act of Incorporation, being chapter 139 and entitled, 'An Act respecting the Ontario and Minnesota Power Company.'

By an order in council, approved by the Governor General on September 19, 1905, the Minister of Public Works and the government of Canada have approved the plans of the Ontario and Minnesota Power Company (copy of the approval appended, marked 'X'). The engineers of the Department of Public Works stated that in so far as the construction of the dam at Koochiching falls is concerned, it will not in any way interfere with navigation above or below the falls at Fort Francis, but will, in fact, be an improvement. The dangerous rapids, two miles above Fort Francis, will be flooded, thereby improving materially the navigation. The freshet waters stored in Rainy lake could be let out during the season of low water, thereby also considerably improving navigation of the river between Fort Francis and the Lake of the Woods. The only objection that could be raised to the proposed elevation of the dam is provided for by a proposed revetment wall to be constructed by the company, and also by a clause in the Act of Incorporation of the company, which makes all damages to lands caused by their works a charge to be borne by them.

The proposed works of the Minnesota Canal and Power Company would interfere with the works authorized by His Excellency the Governor-in-Council. It is expected that soon after the present session of congress, the International Waterways Commission will take up this question.

On November 21, 1905, the chairman of the Canadian section, Mr. J. P. Mabce, having been appointed one of the justices of the High Court of Ontario, resigned, and Mr. George C. Gibbons, K.C., of London, Ont., was appointed in his place chairman of the Canadian section (copy of order in council appended, marked 'Y'). Since Mr. Gibbons' appointment there have been two meetings of the Canadian section, one in Toronto and one in Ottawa, at which the work of the commission has been fully reviewed and the various matters before the commission discussed.

The Canadian section, in conclusion, desire to express their appreciation of the spirit of fairness shown by the members of the United States section in the discussion of all matters.

(Signed) GEO. C. GIBBONS,
Chairman of Canadian Section.

(Signed) W. F. KING,

(Signed) LOUIS COSTE,
Members of Canadian Section.

(Signed) THOMAS COTE,
Secretary of Canadian Section.

Honourable C. S. HYMAN,
Minister of Public Works,
Ottawa, Ont.

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APPENDIX 'A.'

Mr. CHOATE TO THE MARQUIS OF LANSDOWNE.

AMERICAN EMBASSY, LONDON, July 15, 1902.

MY LORD,—Under instructions from my government, I have the honour to inclose herewith four copies of a print of the Act of Congress, approved June 13, 1902, making appropriations for the improvement of rivers and harbours, and at the same time to draw your Lordship's attention to section 4, page 47, of the same, which provides for the appointment of an international commission, to be composed of three members from the United States and three who shall represent the Dominion of Canada, whose duty it shall be to investigate in general the waters adjacent to the boundary line between the United States and Canada, the effect upon the shores produced by changes in the water levels, and the erection and location of a dam at the outlet of Lake Erie. In bringing the matter to the attention of your Lordship, I am instructed to invite His Majesty's government to take part in the formation of the commission in question, and I should be much obliged if your Lordship would be so good as to cause me to be informed at the earliest moment which may be practicable, whether His Majesty's government would be disposed to accept the invitation of my government in this connection.

I have, etc.,

JOSEPH H. CHOATE.

APPENDIX 'B.'

FROM COLONIAL OFFICE TO LORD MINTO.

LONDON, December 2, 1902.

Section 4 of Act of Congress of United States of America, approved June 13 this year, for improvement of rivers and harbours, provides for appointment of international commission of six members, three from Canada, to investigate generally waters adjacent to international boundary, United States invite His Majesty's government to co-operate in formation of commission. What are views of your ministers? Telegraph reply. Papers were sent to Prime Minister July 30.

(Signed)

Secretary of State for the Colonies.

APPENDIX 'C.'

SECRETARY OF STATE FOR THE COLONIES TO THE EARL OF MINTO,

DOWNING STREET, December 3, 1902.

MY LORD,—I have the honour to transmit to your Excellency, to be laid before your ministers, the accompanying copy of a note from the American Ambassador at this court, respecting a proposed international commission to investigate the waters adjacent to the boundary line between the United States and Canada.

I shall be glad to receive any observations which your ministers have to offer at an early date.

A copy of this letter was communicated to Sir W. Laurier on July 30 last, but no answer has yet been received from him.

I have, etc.,

(Signed) ONSLAW,

For the Secretary of State.

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APPENDIX 'D.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by the Governor General on April 27, 1903.

The Committee of the Privy Council have had under consideration a Colonial Office despatch, dated December 3, 1902, transmitting an abstract of section 4, of Act of Congress of the United States, approved June 13, 1902, which provides for the appointment of an international commission of six members, three representing the interests of Canada, and three from the United States, to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada.

The Minister of the Interior, to whom the matter was referred, submits the following recommendations: That His Majesty's government accept the invitation to co-operate in the formation of the commission; and that, as the subjects to be dealt with pertain to the regulations of waters adjacent to the international boundary, thereby affecting harbours and navigation, all surveys and investigations necessary to carry out the intent of the commission be made, as far as Canada is concerned, under the Department of the Interior and the Department of Public Works; and also, that the appointment of the three members of the commission representing the interests of Canada be made on the recommendation of the Minister of the Interior and the Minister of Public Works.

The committee advise that the Governor General be moved to forward a copy of this minute to the Right Honourable the Secretary of State for the Colonies.

All which is respectfully submitted for approval.

(Signed) JOHN J. MCGEE,
Clerk of the Privy Council.

APPENDIX 'E.'

DOWNING STREET, June 6, 1903.

MY LORD,—I have the honour to acquaint your Excellency for the information of your ministers, that, in accordance with the terms of your despatch, No. 167, of May 4, the Secretary of State for Foreign Affairs has informed the United States charge d'affaires that His Majesty's government accept the invitation of the United States government to co-operate in the formation of the commission to investigate the waters adjacent to the boundary line between the United States and Canada.

His Majesty's government accept the suggestion of your ministers as to the appointment of the commissioners, and I presume that steps will now be taken to carry their recommendations into effect and to select the three British representatives.

I have, &c.,
(Signed) J. CHAMBERLAIN.

APPENDIX 'F.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by His Excellency the Governor General, on December 3, 1903.

The Committee of the Privy Council have had under consideration a cablegram, dated October 16, 1903, from the Right Honourable the Secretary of State for the Colonies, transmitting the names of the three gentlemen appointed by the President of the United States as members of the proposed International Waterways Commission.

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The Minister of the Interior, to whom the said despatch was referred, recommends that Mr. William Frederick King, Chief Astronomer of the Department of the Interior, be appointed as one of the Canadian members of such commission.

The committee advise that the Governor General be moved to so inform the Right Honourable the Secretary of State for the Colonies.

All which is respectfully submitted for approval.

(Signed) JOHN J. McGEE,

Clerk of the Privy Council.

APPENDIX 'G.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by His Excellency the Governor General, January 7, 1905.

The Committee of the Privy Council have had under consideration a despatch, herewith, from the Right Honourable the Secretary of State for the Colonies, numbered 306 and dated October 28, 1904, relating to the proposed International Commission to investigate and report upon the conditions and uses of the waters adjacent to the boundary line between the United States and Canada, and inviting the government of Canada to take the question of the appointment of the additional Canadian representatives into early consideration.

The Minister of the Interior, to whom the said despatch was referred, states that by an Act of Congress of the United States, passed in 1902, provision was made for the appointment of three persons to investigate the conditions and uses of the waters tributary to the River St. Lawrence, these persons to be one officer of the Corps of Engineers of the United States Army, one civil engineer well versed in the hydraulics of the Great Lakes, and one lawyer of experience in questions of international and riparian law.

The Minister also states that provision was further made for an invitation to the government of Great Britain to appoint an equal number of commissioners who should represent the interests of the Dominion of Canada.

The invitation having been extended, the formal assent of the government of Canada was given by minute—— of council, dated April 27, 1904, in which it was provided that the representatives of Canada should be named by the Minister of the Interior and the Minister of Public Works.

The Minister further states, that at a later date the President of the United States named his three Commissioners, and Mr. W. F. King, of the Department of the Interior was appointed by order in council on the recommendation of the Minister of the Interior.

The committee recommend that James Mabee, Esquire, K.C., of Toronto, and Louis Coste, Esquire, engineer, of Ottawa, be appointed commissioners in conjunction with Mr. King on the proposed International Commission.

The committee advise that the Governor General be moved to forward a copy of this minute to the Right Honourable the Secretary of State for the Colonies.

All of which is respectfully submitted for approval.

(Signed) JOHN J. McGEE,

Clerk of the Privy Council.

APPENDIX 'I.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by the Governor General on May 20, 1905.

The Committee of the Privy Council, on the recommendation of the President of the Privy Council, advise that James P. Mabee, Esquire, K.C., of Toronto, be appointed

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chairman of the Canadian Commissioners to investigate the conditions and uses of the waters tributary to the River St. Lawrence, adjacent to the boundary lines between the United States and the Dominion.

(Signed) JOHN J. McGEE,
Clerk of the Privy Council.

APPENDIX 'J.'

OTTAWA, January 6, 1905.

SIR,—I have the honour to inform you that by a minute of the Privy Council, dated January 7, 1905, His Excellency the Governor General has been pleased to appoint Messrs. J. P. Mabee, K.C., of Toronto, and Louis Coste, C.E., of Ottawa, additional members of the International Commission to investigate and report upon the conditions and uses of the waters adjacent to the boundary line between the United States and Canada, to which you were appointed on December 3, 1903.

I inclose a copy of the minute of council appointing these gentlemen, and also an extract from the American statutes authorizing the appointment of the United States members of the commission.

Among the subjects that may come up for consideration before this commission are:

1. The proposed diversion southward by the Minnesota Canal and Power Company of Duluth, of certain waters in the State of Minnesota, that now flow north into the Rainy river and the Lake of the Woods.

2. The diversion about a mile and a half east of the town of Sault Ste. Marie of part of the waters of the St. Marys river into the Hay canal entirely through American territory. The river St. Marys now form part of the boundary between the United States and Canada, and the waters of the river are clearly international. The Canadian vessels of necessity are using the Hay canal, but no treaty has been made concerning their right.

3. Enquiry into the effect of the levels of Lakes Huron and Erie by the construction of the Chicago canal.

4. The building of the dam and other obstructions on the St. John river, flowing through the State of Maine into New Brunswick, contrary to the express stipulation of the Ashburton treaty.

The government are of the opinion that the Canadian members of the commission should come together at an early date, and I have so informed Messrs. Mabee and Coste, and asked them to confer with you as to the date of meeting.

It is proposed to appoint Mr. Thomas Côté, journalist, of Montreal, as secretary to the Canadian section of the commission.

I have the honour to be, sir,

Your obedient servant,

(Signed) R. W. SCOTT,
Secretary of State.

W. F. KING, Esq.,
Chief Astronomer,
Department of the Interior, Ottawa.

APPENDIX 'K.'

DEPARTMENT OF STATE,

WASHINGTON, April 15, 1905.

SIR,—Referring to your letter of the 10th ultimo, asking as to the instructions which may be required by the American Commissioners appointed under section 4
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of the River and Harbour Act of 1902 (32 Sta. L., 373), especially in regard to a question which you state is likely to arise concerning the scope of the commission's investigation, the Canadian members appearing to be disposed to regard it as taking in all waters adjacent to the boundary line, whether part of the Great lakes or not. I have to state as follows:—

The wording of the law will be seen by reference to the inclosed copy. The Department's opinion is that the words 'including all of the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic Ocean,' are intended as a limitation on what precedes them, and that the investigation and report should cover only such waters, omitting the lower St. Lawrence itself as well as all other waters not discharging naturally through it.

The broader interpretation given to the Act by the Canadian authorities should be rejected, if for no other reason on account of the smallness of the appropriation for the support of the American section. Congress could hardly have intended to provide with a sum of \$20,000 for the expenses incident to an investigation extending to the Pacific coast, and possibly embracing the Alaskan boundary as well.

A portion of the report of the chairman of the River and Harbour Committee, when reporting the bill (copy of Act herewith), treats of section 4, and would appear to limit the scope of the investigation to the Great Lakes system.

When the ground to be covered has been defined, the law itself appears to be sufficiently detailed to serve as instructions to the American Commissioners.

It seems sufficient, therefore, at the present stage to inform you and the other members of the American section of the views held by the Department as to the scope of the investigation and report, and to request the American Commissioners to assemble and organize as soon as possible after the 20th instant, at this capital, and to submit, after discussion, their own recommendations as to further procedure.

I inclose, also, for your information, copies of letters from Colonel Ernst and Professor Williams in regard to the place of meeting of the commission.

Copies of your letter of the 10th ultimo, and of this, the Department's reply, have been addressed to Colonel Ernst and Professor Williams for their guidance.

I am, sir, your obedient servant,

(Signed) F. B. LOOMIS,
Acting Secretary.

GEO. CLINTON, Esq.,
Commissioner of the United States,
International Waterways Commission,
1012 Prudential Building, Buffalo, N.Y.

APPENDIX 'L.'

TO HIS EXCELLENCY THE GOVERNOR GENERAL:

The undersigned has the honour to represent that on May 4, last, he submitted to Your Excellency's predecessor a minute of the Executive Council of New Brunswick, calling attention to the erection by the St. John Lumber Company—a United States incorporation—of certain piers and booms in the St. John river, near the village of Van Buren, in the State of Maine, and advised that the attention of the government of the United States be drawn to the subject, with a view to the removal of the obstruction complained of, the erection of which it was pointed out constitutes a violation of Article III. of what is commonly known as the Ashburton Treaty of 1842; providing that the navigation of the St. John river shall be free and open to both parties and shall in no way be obstructed by either. No answer appears to have been received to this communication.

The undersigned has now the honour to submit to Your Excellency a petition signed by Mr. J. Fraser Gregory, on behalf of certain lumbermen and mill-owners

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of St. John in convention, pointing out that not only has no action been taken on the petition of the provincial government of New Brunswick, but a bill is actually before the legislature of the State of Maine having for its object the incorporation of another company with powers to construct further piers in the said river almost immediately below those built by the St. John Lumber Company, which formed the subject of the previous remonstrance. Messrs. Gregory and his associates point out that if the proposed fresh obstructions are allowed to be erected, great damage will ensue to Canadian lumbermen and mill-owners along the St. John river. The undersigned, concurring in this view, recommends that a copy of this memorial be transmitted to His Majesty's Ambassador at Washington, and that Sir Mortimer Durand be again requested to bring the subject to the early attention of the United States authorities with a view not merely to the removal of the obstruction immediately complained of, but also to the postponement of any action on the part of the Maine legislature with respect to legislation in the direction indicated above, until the International Commission which has recently been appointed to consider the whole question, shall have made its report.

All of which is respectfully submitted.

(Signed) R. W. SCOTT,

OTTAWA, February 1, 1905.

Secretary of State.

FROM LORD GREY TO SIR MORTIMER DURAND.

OTTAWA, February 3, 1905.

SIR,—With reference to my predecessor's despatch, No. 38, of May 5, 1904, requesting that representations might be made to the United States government in regard to the erection of certain piers and booms in the St. John river, which was considered by this government to involve a violation of article III. of the Ashburton Treaty of 1842, I have the honour to inclose a copy of a further report from the Secretary of State of Canada, submitting a petition from certain lumbermen and mill-owners of St. John, New Brunswick, in which it is pointed out that so far from action having been taken to remove the obstruction to the navigation of the river of which complaint was made, a bill is now before the Maine legislature to incorporate a company with power to construct other piers which will cause further damage to Canadian interests.

Your Excellency will observe that the minister suggests that the matter again be brought to the attention of the United States authorities, with the view of obtaining the removal of the obstructions complained of, and postponement of action on the bill referred to, until the International Waterways Commission, recently appointed, shall have made its report.

I have, &c.,

(Signed) GREY.

HIS EXCELLENCY THE RIGHT HONOURABLE

SIR MORTIMER DURAND, G.C.M.G., Etc., Etc., Etc.

APPENDIX 'M.'

SIR H. M. DURAND TO LORD GREY.

BRITISH EMBASSY, WASHINGTON, February 27, 1905.

MY LORD,—On receipt of your Excellency's despatch, 3rd, relative to the erection of further piers in the St. John river, I at once addressed a note to the United States government bringing the matter to their notice, and suggested that action be deferred on the bill pending before the Maine legislature, and that obstructions already erected should be removed.

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I have now the honour to transmit copy of the note which I have received from the United States Secretary of State in reply.

I have, etc.,

(Signed) H. M. DURAND.

APPENDIX 'N.'

DEPARTMENT OF STATE,

WASHINGTON, February 24, 1905.

EXCELLENCY,—I have conferred with my colleagues of the Departments of War and Justice touching the suggestion made in your note of February 11, at the instance of the Canadian government, that it would appear desirable that until the recently appointed commission on international waterways has submitted its report, action should be postponed upon a bill now before the Maine legislature providing for the incorporation of a company with power to construct piers in the St. John river, additional to those complained of in your prior note of May 9, 1904, and that, meanwhile, the obstructions already erected should be removed.

It is the view of my colleagues that, under the 4th section of the River and Harbours Act of June 13, 1902, the function of the International Waterways Commission, the creation of which was authorized and invited by that Act, do not extend beyond the execution of the purposes therein defined, namely, the investigation of the problems of water level, water supply and navigation in the Great Lakes and tributary streams having their natural outlet by the River St. Lawrence to the Atlantic ocean. The St. John river does not belong to the water system intended to be investigated, and consequently the future report of the International Waterways Commission would have no relation to the complaint now presented. It would remain a separate matter for consideration.

The attention of the Attorney General has again been called to the matter of the existing obstructions in the St. John river.

I have, etc.,

(Signed), JOHN HAY.

APPENDIX 'O.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by the Governor General, on March 25, 1905.

The Committee of the Privy Council have had under consideration a despatch dated February 27, 1905, from His Majesty's Ambassador at Washington, concerning the scope of the International Waterways Commission.

The Minister of Public Works, to whom the question was referred, observes that the United States Secretary of State draws attention to the fact that the Act of Congress authorizing the creation of the commission, does not extend beyond the execution of the purposes therein defined, viz.: 'The investigation of the problems of water level, water supply and navigation on the Great Lakes and tributary streams having their natural outlet by the River St. Lawrence to the Atlantic ocean.'

The minister further observes that the Secretary of State states that as the St. John river does not belong to the water system intended to be investigated, the future report of the International Waterways Commission can have no relation to a complaint made concerning work executed and to be executed on the St. John river, which would, therefore, remain a separate matter for consideration.

The Minister, in view of the above statement, which would go far to restrict the range and scope of the International Waterways Commission, has procured a copy of the Act of Congress above referred to, and submits a verbatim copy of section 4 of

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chapter 1079 of the statutes of the United States, passed by the 57th Congress, the section in question being as follows, that is to say:—

‘That the President of the United States is hereby requested to invite the government of Great Britain to join in the formation of an International Commission, to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary line between Canada and the United States, including all of the waters of lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean, also upon the maintenance and regulation of suitable levels; and also upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation by reason of the diversion of these waters from or change in their natural flow, and further to report upon the necessary measures regarding such diversion, and to make such recommendation for improvements and regulations as shall best subserve the interests of navigation in said waters.

‘And said commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective governments looking to an agreement or treaty which shall provide for the construction of the same; and they shall make an estimate of the probable cost thereof.’

The Minister further observes that throughout the correspondence which has taken place, prior to the appointment of the Canadian section of the commission, the terms used have always been identical to those of the Act above referred to, and that it has always been understood that the investigation would bear upon the conditions and uses of the waters adjacent to the boundary line between Canada and the United States, the other waters belonging to the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean, being stated to be also included therein, but the general scope of the commission being especially intended to apply to all waters adjacent to the boundary line between Canada and the United States.

The Minister, therefore, is of the opinion that in the despatch under his consideration an unintentional misapprehension has existed as regards the terms of the Act of Congress, and that it is fit and proper that the work of the commission be not restricted to narrower limits than those indicated by the said Act.

The Minister, therefore, recommends that the necessary representations be made in order that the investigation to be carried on by the said commission, and the report to be based thereon, shall extend to all the waters adjacent to the boundary line between Canada and the United States, and, therefore, include such portions of the St. John river as will come within the limit assigned by the Act of Congress to the work of the commission.

The committee advise that His Excellency be moved to forward a copy of this minute to His Majesty's Ambassador at Washington.

All of which is respectfully submitted for approval,

(Signed. JOHN J. MCGEE,

Clerk of the Privy Council.

APPENDIX ‘P.’

DEPARTMENT OF STATE,

WASHINGTON, May 31, 1905.

EXCELLENCY,—I have the honour to acknowledge the receipt of Mr. O’Beirne’s note of the 22nd instant, by which he informs me that he is instructed by Lord Lansdowne to express the hope that the United States government will see its way,

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without necessarily conceding the principle of its contention as to the scope of the Waterways Commission, to agree to the wish of the Canadian government that the commission should deal with the question of the obstruction of the St. John river.

Serious consideration has been given to Mr. O'Beirne's note, and I regret to reply that this government is unable to accede to the Canadian government's wish. As your embassy has been advised in a former note, this government's construction of the Act of Congress is that the Waterways Commission created thereunder has no jurisdiction over the St. John river; and in the opinion of this government such jurisdiction can be exercised only by authority of Congress. Moreover, as the questions which have arisen regarding the St. John river affect particularly the State of Maine and the province of New Brunswick, such questions should be considered only by a commission on which both of them shall be represented.

I think I can assure Your Excellency that Congress will, in the early part of its next session, provide for a commission, to be joined with one from Canada, to examine fully into the questions in controversy between the business interests of Maine and those of New Brunswick with regard to the St. John river, and this government sees no reason why the whole matter may not be satisfactorily adjusted by such a commission within a short period of time.

I have the honour to be, &c.,

(Signed) F. B. LOOMIS,
Acting Secretary.

The Right Honourable Sir H. M. DURAND, &c.

APPENDIX 'Q.'

INTERNATIONAL WATERWAYS COMMISSION.

(Canadian Section.)

SECRETARY'S OFFICE,

OTTAWA, June 2, 1905.

Hon. W. S. FIELDING,

Minister of Finance,

Acting Minister of Public Works, Ottawa, Ont.

DEAR SIR,—By direction of the Canadian section of the International Waterways Commission, I have the honour to report as follows:—

On May 11 last, the American Commissioners met in Washington and decided to invite the Canadian section to a joint meeting, to be held in Washington on the 25th of the same month.

The commission actually met at the office of Colonel O. H. Ernst on May 25, at 10.30 a.m. There were present: Mr. J. P. Mabee, chairman of the Canadian section; Messrs. W. F. King and Louis Coste, members of the Canadian section, and Mr. Thomas Côté, secretary of the Canadian section; Colonel O. H. Ernst, chairman of the American section; Professor Gardner S. Williams and Mr. George Clinton, members of the American section.

The commission proceeded in a body to call upon the Secretary of State, and after a brief interview with Mr. F. B. Loomis, first assistant and acting secretary, returned to the first place of meeting, and devoted several hours to an informal discussion of the organization, permanent place of meeting, and scope of duties of the commission, but came to no conclusion thereon, and at 1.45 p.m. adjourned to meet the next day at 11 o'clock a.m.

On May 26, the commission met again at the office of Colonel Ernst, at 11 o'clock a.m. There were present all the members of the joint commission and the secretary of the Canadian section. An organization was effected by the election of Colonel

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Ernst as chairman of this meeting, it being agreed that at meetings of the full commission held on American territory the chairman of the American section should preside, and at meetings held on Canadian territory, the chairman of the Canadian section should preside.

It was decided that for the present the offices of the Canadian section should be established in Toronto, and those of the American section in Buffalo, and that full meetings should be held in one or the other city from time to time, as should be found most convenient.

The American section presented the instructions under which they are acting, as embodied in the following letter, viz.:—

‘DEPARTMENT OF STATE,

‘WASHINGTON, D.C., April 15, 1905.

‘GEORGE CLINTON, Esq.,

‘Commissioner of the United States,

‘International Waterways Commission,

‘1012 Prudential Building, Buffalo, N.Y.

‘SIR,—Referring to your letter of the 10th ultimo, asking as to the instructions which may be required by the American commissioners appointed under section 4 of the River and Harbour Act of 1902 (Statutes-at-large, volume 32, page 375), especially in regard to a question which you state is likely to arise concerning the scope of the commission's investigation, the Canadian members appearing to be disposed to regard it as taking in all waters adjacent to the boundary line, whether part of the Great Lakes or not, I have to state as follows:—

‘The wording of the law will be seen by reference to the inclosed copy. The department's opinion is that the words, “including all the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean,” are intended as a limitation of what precedes them, and that the investigation and report should cover only such waters, omitting the lower St. Lawrence itself, as well as all other waters not discharging naturally through it.

‘The broader interpretation given to the Act by the Canadian authorities should be rejected, if for no other reason, on account of the smallness of the appropriation for the support of the American section. Congress could hardly have intended to provide, with a sum of \$20,000, for the expenses incident to an investigation extending to the Pacific coast, and possibly embracing the Alaskan boundary as well.

‘A portion of the report of the chairman of the River and Harbour Committee, when reporting the bill (copy of Act herewith) treats of section 4, and would appear to limit the scope of the investigation to the Great Lakes system.

‘When the ground to be covered has been defined, the law itself appears to be sufficiently detailed to serve as instructions to the American commissioners.

‘It seems sufficient, therefore, at the present stage, to inform you and the other members of the American section of the views held by the department as to the scope of the investigation and report; and to request the American commissioners to assemble and organize, as soon as possible after the 20th instant, at this capital, and to submit, after discussion, their own recommendations as to further procedure.

‘I inclose also, for your information, copies of letters from Colonel Ernst and Professor Williams, in regard to the place of meeting of the commission.

‘Copies of your letter of the 10th ultimo and of this, the department's reply, have been addressed to Colonel Ernst and Professor Williams for their guidance.

‘I am, sir, your obedient servant,

‘(Signed) F. B. LOOMIS,

‘Acting Secretary.’

The Canadian section then communicated to the American Commissioners the views of the Canadian government, which are embodied in the following extract from

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a report of the Committee of the Honourable the Privy Council, approved by the Governor General on March 25, 1905:—

‘The Committee of the Privy Council have had under consideration a despatch, dated February 27, 1905, &c., &c.’

(See order in council, referred to under heading of appendix ‘O,’ page 26, of this report.)

The Canadian section then presented the following memorandum:—

‘The Canadian members of the International Waterways Commission had understood the scope of the commission to be wider, &c., &c.’

(This memorandum will be found at page 6 of this report.)

(Signed) J. P. MABEE,

WASHINGTON, D.C., May 26, 1905.

Chairman Canadian Section.

The chairman of the American section stated that he was informed that the British government had communicated with the American government through diplomatic channels, requesting that the broader interpretation above described be given to the law of Congress, providing for the commission, that the American government had the matter under consideration, and that a decision could not be expected before the return of Secretary Taft to the city on Monday the 29th, or Tuesday the 30th ultimo.

It was decided that further action be deferred until the decision be given, and until further instructions be received from the two governments. It was further decided that the decision of the American government should be communicated to the chairman of the Canadian section as soon as received, and that if it be favourable to the Canadian interpretation of the law, or if it be unfavourable and be accepted by the Canadian government, then a meeting of the commission shall be called at Ottawa by the chairman of the American section at as early a date as may be convenient to the members.

At 12.30 p.m. the commission took recess until 4 p.m.

The commission reconvened at 4 p.m., and having heard the minutes of preceding meetings read, approved them, and then adjourned *sine die*.

On Monday, May 29, I called at the British Embassy and handed to His Excellency the Right Honourable Sir H. Mortimer Durand, copy of the minutes of the proceedings of the preliminary meetings of the commission. He informed me that he would call on Wednesday, May 31, on Secretary of War Taft and on Acting Secretary of State Loomis, to press again the Canadian interpretation of the Act of Congress, passed in 1902, and authorizing the formation of the commission.

I have received to-day from Mr. O’Beirne, Secretary of the British Embassy and the charge d’affaires in Washington, during the absence of Sir H. Mortimer Durand, the following telegram: ‘This government regret they cannot agree with your commission dealing with St. John river. Have wired fully Governor General. (Signed) O’Beirne.’

The Canadian section is now awaiting further instructions from His Excellency the Governor General in council.

All of which is respectfully submitted.

(Signed) THOMAS COTE,

Secretary Canadian Section.

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APPENDIX 'R.'

INTERNATIONAL WATERWAYS COMMISSION,
(American Section)

OFFICE OF CHAIRMAN, ROOM 328, MILLS BUILDING,
WASHINGTON, D.C., June 2, 1905.

DEAR SIR,—I have the honour to inform you that our government has found itself unable, after very serious consideration of the question, and after having submitted it to the Attorney General, to accede to the desire of the Canadian government to include the St. John river within the scope of the commission's work, and that I am authorized to communicate this decision to you informally. It has been communicated formally to the British government through diplomatic channels.

I am further authorized to assure you that it is the firm expectation of our government that our Congress will, in the early part of its next session, provide for a commission to work jointly with one from Canada to examine fully into the questions in controversy between the business interests of Maine and New Brunswick, with regard to the St. John river.

Allow me to express the hope that this decision will not prevent the prosecution of the work of the commission within the field prescribed to the American section, as communicated to you at our session held here on the 25th and 26th ultimo, and that I shall have many opportunities for renewing the agreeable acquaintance so auspiciously begun on that occasion.

Yours very respectfully,

(Signed) O. H. ERNST,
Colonel, Corps of Engineers, Chairman American Section.

J. P. MABEE, Esq.,
Chairman Canadian Section,
International Waterways Commission,
Bank of Toronto Building, Toronto, Canada.

APPENDIX 'S.'

INTERNATIONAL WATERWAYS COMMISSION,
(Canadian Section)

OFFICE OF CHAIRMAN, BANK OF TORONTO BUILDING,
TORONTO, June 7, 1905.

MY DEAR SIR,—I have the honour of acknowledging yours of June 2, advising me that the government of the United States, after very serious consideration, has found itself unable to accede to the desire of the Canadian government to include the St. John river within the scope of the commission's work, but at the same time assuring me that it is the firm expectation of your government that Congress will, in the early part of its next session, provide for a commission, to work jointly with one from Canada, to examine fully into the questions in controversy between the business interests of Maine and New Brunswick with regard to the St. John river.

The final position taken by your government has been laid before the government of Canada, and I have the honour of informing you that with full reliance of your assurance relating to the unfortunate differences regarding the uses of the waters of the St. John river, our government has authorized the Canadian Commissioners to proceed with the inquiry within the field prescribed by the interpretation placed upon the Act of Congress by your Attorney General, and at the same time, I am specially charged by the Premier of Canada to draw the attention of your section of the commission to the condition of matters along the St. John river, and to the necessity of prompt joint action thereon.

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A meeting of our section has been called for to-morrow, and I shall advise you at once of the date suggested for a joint meeting, pursuant to our arrangement at Washington.

Personally, I am gratified at the conclusion arrived at by our government, and I am sure that my brother Commissioners of the Canadian section will look forward with great pleasure to the future joint meetings of the commission.

Believe me, my dear sir, yours very respectfully,

(Signed) J. P. MABEE,

Chairman of Canadian Section International Waterways Commission.

COLONEL O. H. ERNST,

Chairman American Section,

International Waterways Commission,

Mills Building, Washington, United States of America.

APPENDIX 'T.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by the Governor General, on November 29, 1905.

On a report dated November 17, 1905, from the Minister of Public Works, submitting that at a meeting of the International Waterways Commission in the city of Buffalo, state of New York, on October 28, 1905, the following two resolutions, having reference to the use for manufacturing purposes of the waters of the River St. Mary and of River Niagara, were proposed and adopted:

'RESOLVED:—That this Commission recommends to the Governments of the United States and Canada that such steps as 'they may regard as necessary be taken to prevent any corporate right or franchises being granted or renewed by either Federal, State or Provincial authority, for the use of the waters of the Niagara River for power or other purposes until this Commission is able to collect the information necessary to enable it to report fully upon the 'conditions and uses' of those waters to the respective governments of the United States and Canada.'

(Signed) J. P. MABEE,
Chairman, Canadian Section.

(Signed) O. H. ERNST,
Chairman, American Section.

'RESOLVED:—That in the opinion of this Commission no further rights or franchises should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior, by either the government of the United States or Canada, until all data and information are in the hands of the Commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such privileges be granted, they be subject to any regulations that may be adopted by both governments.'

(Signed) J. P. MABEE,
Chairman, Canadian Section.

(Signed) O. H. ERNST,
Chairman, American Section.

The Minister recommends—with a view to ratifying the above regulations—that the Government of Ontario be communicated with, laying before that government contents of said resolutions, with a request that such means be adopted as may be thought proper to ensure their being carried out.

The Committee submit the same for approval.

(Signed) JOHN J. MCGEE,
Clerk of the Privy Council.

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APPENDIX 'U.'

Whereas, by the River and Harbour Act, approved June 13, 1902, it is provided (32 Stats. L., 361) that, subject to the conditions therein mentioned:

'The Michigan Lake Superior Power Company, of Sault Ste. Marie, Michigan, its successors and assigns, after first obtaining consent of the Secretary of War and the Chief of Engineers and their approval of the said canal and remedial works proposed, is hereby authorized to divert water from St. Marys river into its water-power canal, now being constructed at Sault Ste. Marie, Michigan, for water-power purposes, while and so long as such works and diversion of water from said river shall not injuriously affect navigation therein, nor impair or diminish the water levels or any natural increase thereof, either in Lake Superior, or in the United States ship canal and locks, or the navigable channels, locks, or ship canals connected therewith, whether natural or artificial, now existing or which may hereafter be established or created by the United States for navigation purposes.'

And Whereas the said Michigan Lake Superior Power Company has submitted for the approval of the Secretary of War and the Chief of Engineers plans of its water-power canal and remedial works for the diversion of the water from the St. Marys river, authorized by said Act, and has applied for consent of the Secretary of War and Chief of Engineers to such diversions;

And Whereas, the Chief of Engineers has approved the said plans and has given his consent to such diversion, subject to the acceptance by said company of the conditions hereinafter specified:

Now, Therefore, this is to certify that the Secretary of War hereby approves the said plans, which are hereto attached, and hereby gives his consent to the diversion of water from the St. Marys river, as authorized by said Act, subject to the acceptance by said company of the following conditions:

1. That the regulation works, including escape valves at power, controlling works, and remedial works, shall be operated under the inspection of the engineer officer in charge of the St. Marys Falls Canal, who shall have access to them at all times.

2. That when the mean level of Lake Superior at the canal for any calendar month falls below 601.5 feet above mean tide at New York, according to the levels of the United States Lake Survey Office, the flow through the canal shall be reduced, the amount of reduction increasing as the monthly mean level falls until it reaches 601:0, when all flow shall be stopped until the monthly mean level again exceeds 601:0, all without claim against the United States or against any officer thereof.

3. That in addition to the requirements of conditions 2 (supra), all flow shall likewise be stopped, without claim against the United States, or against any officer thereof, should the monthly mean level of the lake remain below 601.5 for a period of six consecutive calendar months, and shall not be resumed until the monthly mean level shall exceed 601.5.

4. That when the monthly mean level rises above 603.0, the flow through the canal and the remedial works shall be increased to their maximum capacity, and shall so continue until the monthly mean level shall be less than 603.0, without claim against the United States or against any officer thereof.

5. That should the monthly mean level of the lake remain above 603:0 for a period of six consecutive calendar months, said company shall alter its work at its own expense as soon as practicable, so as to allow more flow.

6. That the United States shall have the right to assume entire control of the flow of water through the canal and remedial works in cases of accidents, or of emergencies temporarily affecting navigation through the United States ship canal.

7. That should cross currents detrimental to navigation be created by the intake or by the outflow of the canal, said Company shall construct such booms, training walls, or other works as may be necessary to remedy the evil.

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8. That said Company, in its arrangement and construction of remedial works shall leave a suitable channel and water flow for the passage of logs over and through St. Marys falls.

9. That these limitations are in addition to the special limitations of the Act of June 13, 1902, regarding riparian or other rights of any person or corporation and the remedies therefor.

10. That the elevations above mean tide at New York, above specified, are those established and in use at this date by the office of the survey of the northern and northwestern lakes, commonly known as the Lake Survey Office, at Detroit, Michigan.

11. Finally, the object and aim of the foregoing paragraph being to hold the waters of the lake and river under the absolute control of the United States in the interest of navigation, it is expressly understood that said company shall not be entitled to damages should the government at any time or for any cause exercise its right to control and suspend the flow of water through the power canal, in the interest of navigation.

Witness my hand this 12th day December, 1902.

(Signed) ELIHU ROOT,
Secretary of War.

This instrument is also executed by the Michigan Lake Superior Power Company, by Francis H. Clergue, its president, thereunto lawfully authorized, this 9th day December, 1902, in testimony of the acceptance by said company of the foregoing conditions.

THE MICHIGAN LAKE SUPERIOR POWER COMPANY.

(Signed) BY FRANCIS H. CLERGUE, President

Attest:

H. VON SCHON,
F. T. TREMPÉ.

(Seal)

APPENDIX 'V.'

(Translated from the original.)

THOMAS CÔTÉ, Esq.,
Secretary International Waterways Commission,
Ottawa, Ont.

SIR,—At your request I went to Niagara in the latter half of October last. The object was, as you had written me a few days before, to determine whether the cataract will continue to recede at a rate equal to that observed since 1842.

There is no need to point out that a problem, to which geologists have already given years of work without having attained an absolutely certain result, could hardly be solved by a few days' study. However, my visit to Niagara was very useful to me, inasmuch as I could thereby verify *de visu* the facts already published, to say nothing of the personal observations which I was enabled to make.

The result of my studies upon this question is briefly summarized in the report which I now have the honour to submit. You will observe that of the authors whom I quote in my paper, not one is Canadian. I thought this would be preferable, with regard to our American friends, since it closes the door to the slightest suspicion of partiality.

I have the honour to be, sir, your obedient servant.

(Signed) J. C. K. LAFLAMME.

QUEBEC, November 9, 1905.

SESSIONAL PAPER No. 19

NOTES ON THE RETROCESSION OF NIAGARA FALLS.

Summary.

1. Uncertainties of the geological chronicle as relating to the hollowing out of the gorge and to the retrocession on the falls of Niagara.
2. Character of the retrocession of the cataract.
3. Irregular course of the erosion at Niagara, in the past and in the future.
4. Limit of the rapid retrocession.
5. Secular oscillations of the basin of the Great Lakes and their influence on Niagara river.
6. Variations of the volume of water in the river, both on the Canadian and on the American side.
7. Influence of the electric works on the cataract.
8. Conclusion.

1. I will not undertake to give either the geological history of the Niagara river or that of the falls. The history of the past has no part in the programme assigned to me. Moreover, to estimate what Niagara has been, through bygone geological ages, is an extremely complex problem. For more than half a century many great geologists, Canadian and American, have thoroughly studied the subject. In spite of their labours, and notwithstanding all the hypotheses, born of their investigations, or perhaps owing to these very hypotheses it must be confessed that the question is far from being solved. If, in the main, the history of the falls is now fairly well known, the details are yet ungrasped. And in the present instance the details are of more importance than the general facts definitely recognized by science.

This disagreement among geologists becomes more evident when it is remembered that some of the best known assign 5,000 years as the time taken by the cataract to cut out its bed from the heights of Queenston to its present site, while others, of equal scientific standing, assert that no less than 50,000 years were required for hollowing out Niagara's gorge. Between these extreme figures are to be found the estimates of many others, which suffices to show that upon this point of the history of Niagara, agreement is far from absolute, and to prove also how uncertain and how susceptible to different interpretations are the data upon which we have to work.

I might perhaps say as much in regard to the specific question of the retrocession of the fall. The fact is known to almost everyone. But it is only since 1842 that measurements were made and that definite data were obtained.

Before that time, from Father Hennepin, in 1673, to the triangulation by James Hall, in 1842, it could be said that the Horseshoe had retreated, but to what extent no one could definitely ascertain.

As it is this retrocession of the falls which I have had more particularly to study, it may be well to detail the actual process as agreed on by all geologists.

2. On the whole length of the crest of the cataract, water flows over a thick bed of dolomitic limestone.

The upper layers, much broken and furrowed, overlie other parallel strata, more compact and more resisting. The whole is what is called the Lockport or Niagara limestone. It is over the first series of these strata that the water of the river descends from the head of the rapids to the cataract.

Under this limestone, and parallel to it, lies a mass of foliated compact argillite, that constitutes almost all of the lower portion of the bank. These schistose masses are demolished both by the rebound from below and the direct attack of the falling waters from above. They crumble and disappear, so that sooner or later the limestone layers above become overhanging, when deprived of the support which upheld them, then give way under the weight of the rushing water, and in falling cause the crest of the cataract to recede. Later, the same process is repeated, bringing about each time retrocession of the crest.

It is not then, as might be thought, the friction, although enormous, of the water, which wears away the layers of the bottom and causes them little by little to disap-

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pear; it is, rather, the destruction of the support of these beds which brings about their fall in large or small quantities. The process is one of demolition rather than one of erosion or dissolution.

3. Consequently, the extent of the retrocession, its direction and its limit, all depend on data rather difficult to elucidate in detail, should there be reached a greater hardness in the argillitic lower beds; or again, should the limestone strata become more compact and more resisting, the retrocession will become slower. Reverse modifications in the physical condition of the beds would hasten it.

Differences on the resistance of the geological strata have equally to be taken into account when it is a question of forecasting the direction in which the retrocession will take place. Such direction must be largely influenced by the fact that through the vast expanse of the Horseshoe some parts will naturally give way more easily than others under the disintegrating action of the waters. Finally, it must not be forgotten that if the mass of waters be greater at one point than another, the limestone will break away sooner there than elsewhere, and the retrocession at such a point will be to the extent accelerated.

This will explain why the retreating of the Canadian falls is three or four times more rapid than that of the American; why it takes place, so to speak, by spells, now quickly, now slowly*; why again it is more pronounced at certain points of the Horseshoe than at others; and why, lastly, it happens that it is not always most marked where there is most water.

It is therefore evident that the yearly rate of retreat of the cataract is continually varying, but further inquiry may make it questionable whether the figures given are strictly accurate. It must be remembered that the exact determination of the crest line of the Horseshoe, on which depends the estimation of the extent of the retrocession, can only be determined by a very minute triangulation based upon a certain number of fixed points on the shores and other points equally stable selected along the crest itself. Now, nothing is more unstable than a sheet of falling water. It may happen, and doubtless it does sometimes happen, that some of the points selected as guiding marks on the crest of the falls are not recognizable at the different stations or are confounded with nearby marks.

This explains certain anomalies to be found in the profiles of the Horseshoe as traced in 1842, 1875, 1886 and 1890, and reproduced by Mr. Spencer in 1894.† Unquestionably the strangest of them is to find that the profile of the Horseshoe is farther back in 1886 than in 1890, for at this particular point the fall is shown to have come forward during these years instead of receding. The same may be said about the profile of 1875 and 1886; they overlap each other on the west side of the Horseshoe.

Therefore, the problem to be solved, when measuring the retreat, is a very difficult one in its ultimate details, and only approximate figures can be reached, with little importance attaching to the fractions of a foot which the computation may give.

As a general conclusion, it may be said, without fear of contradiction, that we are not sufficiently acquainted with the intimate physical structure of the banks of limestone and shale that occasion the cataract to recede, to state positively either what is the regular rate of retreat, or that it will continue indefinitely, at the same rate, in the direction it has followed during, say, the last fifty years. At the present it seems to follow the outline of Goat island; whether it will always do so, is unknown to us.

In the opinion of Mr. J. W. Spencer, whom I had the pleasure of meeting at Niagara, and whose geological studies of this locality, carried on for many years with an untiring devotion, are of great value, the erosion will continue for a time toward Goat island, after which the western side will be affected.

*Mr. Grabau, in his *Geology and Palætiology of Niagara Falls and vicinity*, p. 83, gives the following figures as representing the mean retrocession of the Horseshoe as evinced by measurements made by Hall in 1842; by the engineers of the Lake Survey in 1875; by R. S. Woodward in 1886, and by M. S. Kibbe, in 1890, Niagara retreated 2:01 feet per year from 1842 to 1875, 1:86 feet from 1875 to 1886, and 5:01 feet from 1886 to 1890. Last summer Mr. Spencer proceeded, with greatest care, to make new determinations of the profile of the cataract. They will, probably, when the computations are finished, give us another figure.

†'Duration of Niagara Falls.' *The American Journal of Science*, Dec., 1894, p. 461.

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A peculiar phenomenon occurs at the falls; powerful jets of water from time to time spout upwards a hundred feet above the crest of the Horseshoe; they appear to be geyser-like explosions, brought about by a sudden very powerful vertical action. Their localization is quite definite. They are only seen where the two sides of the Horseshoe are closest together. It must be remembered that the regularity of the curve that gave the name of Horseshoe to the Canadian fall is now only to be seen at its extremities. The central part more nearly resembles a fairly sharp 'V.' It is at the apex of this 'V' that the vertical spurts take place.

Many think them to be caused by air compressed behind the curtain of the cataract, which it rends from time to time in forcing an outlet. If this be so why should this compressed air not escape at each end of the curtain by following the profile of the escarpment? There is no lack of space, since one can go behind the falling mass of water. Besides, when visiting the Canadian tunnel, which opens behind the enormous fall, there is no sensation of compressed air. Some would certainly exist there, although in a lesser degree than at the centre. Moreover, why should these explosions take place upwards and not perpendicularly to the falling sheet of water? I rather incline to see in them a hydraulic ram effect. The huge mass of rushing water meets jutting rocks, which it strikes with energy sufficient to shoot a part of this water to a higher point than the starting level.

But whatever may be the explanation of these mighty spouts they are an evidence of extreme mechanical action, a powerful process of erosion taking place at the apex of the 'V,' and so long as the crest of the Horseshoe keeps its present profile it must be at that point that the greatest amount of erosion will take place.

The caving in of large areas on the sides of the Horseshoe may modify this state of things and prevent the point of the 'V' from eating away more ground than the rest.

4. Now, to resume the question of the falls, from which these digressions have carried us.

I have attempted, above, to show the uncertainty of the computations hitherto made regarding the rate of retreat. Moreover, even assuming these figures to be accurate, there is doubt if this rate will be maintained invariably and ever constant at the mean of the last fifty years.

As the falls retreat, the thickness of the hard limestone beds increases. It will have reached its maximum when the point of the Horseshoe has arrived at the line of shoals close to the south end of Goat Island. On the other hand, the friable argillitic underpart of the profile of the escarpment decreases in thickness as the falls draw nearer Lake Erie, owing to the general dip of the layers toward the south. Dr. J. H. Clarke, New York State geologist, believes that when the cataract has reached the line of shoals above mentioned, the escarpment will be wholly composed of the limestone strata, the dip of the argillites southward having reached the lower level of the river bed. By that time the fall will have grown some fifty feet higher than it now is, and the retreat, being thereafter exclusively the result of the wear of the limestone, will become slower.

5. A factor that must seriously affect this study of Niagara is the weight of the volume of water precipitated into the chasm. If, as before stated, the volume of water varies, one of the weightiest causes of retreat must also vary in the same proportion, and all the deductions drawn from the present data will suffer should there be any difference in the flow of the Niagara river. Now, geologists tell us that the part of the surface of the American continent that includes the Great Lakes is subject to slow oscillations, which result in a general upheaval on the northeast or a sinking on the southwest. This secular crustal movement, slow, but continuous, will begin by retarding the flow of the water running northeasterly. Then a time will come when Lakes Superior, Michigan, Huron and Erie, instead of draining through Lake Ontario, will send their waters toward the Mississippi through the southern extremity of Lake Michigan.

I may borrow the following figures from Mr. Grabau:* In 2,000 years the Illinois and Niagara rivers will share equally the waters of the Great Lakes. In 2,500 years the Niagara will have but an intermittent flow. In 3,000 years Niagara will be no more, and all the immense hydrographic basin of the Great Lakes, save that of Lake Ontario, will drain into the Mississippi. Therefore, until then, the discharge of Niagara must continually decrease and the eating away of the falls will vary accordingly. We will see later on what is to be thought of these figures.

But before going further, are these crustal movements really so regular and constant as they are said to be? They are found in Scandinavia, in Greenland, and on a number of other coasts. It is also known, however, that they do not occur with regularity, nor do they always work in the same way.

According to Dr. Clarke,† the shore at Percé on the Gaspé coast, which was going down fifty years ago is now rising. Who is not acquainted with the classic example of the famous temple of Serapis, in Italy, which, after having been for a long time buried under water, owing to the settling of the soil, emerged later on, and attained several centuries ago a level that has not varied since?

The crustal movements have every variety of period; some may be secular, some may last a few years only, and to refer specially to the movement which may be affecting Niagara river, nobody yet knows its period. It may continue, it may come to an end, or it may reverse itself. It is, therefore, impossible upon such uncertain data to make very positive assertions, the reliability of which could never go beyond that of the premises. Such was the position lately taken by Dr. Clarke.

Consequently, the possible oscillations of the basin of the Great Lakes are hardly worth taking into consideration in the study of such a problem as we have before us, unless we be willing to extend conjectures to a future so remote as to deprive them of any interest.

6. It may be asked whether the recession of the falls will lessen the quantity of water which now flows along the Canadian shore in the upper rapids. On that score I do not believe that we have much to fear. No matter what direction the retreat may take, we shall always have more water than the Americans. The level of the river bed is lower on our side. The first sill of the upper rapids crosses the whole of the river dipping towards the Canadian shore; at this point it is considerably lower than on the American side. The Canadian fall is about ten feet lower than the American, and the water naturally bears towards our side. If the hollowing out of the Horseshoe should result in a modification of the general level of the river, there is reason to believe that we would not be the sufferers.

Moreover, it must not be forgotten that the Niagara river, where the falls now exist, turns at almost a right angle, from southeast to northwest, and that, consequently, the great mass of its water strikes the Canadian shore before taking its new course.

The American channel hardly carries the surplus. Already, in order to protect the Canadian wall from erosion, special measures have been taken.

The effect of this deviation is all the more accentuated since the bed of the river becomes much narrower at the very point where its course is changed. The flow is, so to speak, choked between Goat island and the Canadian shore. The mass increasing, has a more marked tendency, by virtue of its inertia, to continue on its first course and thereby to bear towards our side.

It therefore matters little to us whether the new Horseshoe gorge in process of formation follows the centre of the river, or, as it had done for the last half century, works its way parallel to the shore of Goat island. I do not believe that the volume of the Canadian waters will be seriously affected thereby.

The same thing cannot be said of the American channel. It will be dry before the new Horseshoe gorge has reached the line which joins the upper end of Goat island to Dufferin islands.

*Loc-cit., p. 65

†Loc-cit., p. 490.

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Already, owing to tapplings made at different points of the river above the falls, the general level has been so modified that nearly every spring, according to the citizens of Niagara, the ice from Lake Erie, not finding enough water to float it, runs aground at the entrance of the American channel and blocks it completely; so that the American fall for a few days ceases to exist. This phenomenon, which was exceptional before the establishment of the electric works, seems to have become an almost annual one.

7. Permit me to make the statement here, although this matter is not directly relevant to my instructions, that the danger which really threatens Niagara falls is not so much from the wearing of its bed as from the abstraction of a large proportion of its waters by the electrical companies now or likely to be established.

Already, according to Dr. Clarke,* when the five electric companies now in operation at Niagara produce to their charter limits and abstract a total of 48,000 cubic feet of water per second, the water level will reach the bottom of the river at the American shore. And if these abstractions are multiplied, always above the falls, the American fall will disappear finally; even the Horseshoe will lose a part of its majestic splendour.

Though, as before observed, this question, an extremely delicate one, whether considered from the standpoint of public or private interests, does not strictly enter into the scope of the present notes, I have deemed it well to place my views on it before the International commissioners, in view of the high competence, of the great influence it is in their power to exercise with the constituted authorities. I may add that the preservation of the falls in their present general state may itself become the object of an International understanding.

So grand a natural phenomenon, which every year attracts, it is said, more than eight hundred thousand visitors, is surely worth considering the insurance of its perpetuity.

On this subject may be read to advantage the very interesting paper by Dr. Clarke, entitled, 'The Menace to Niagara,' published in the *Popular Science Monthly* for April last, and from which I have freely borrowed for the present report. In it the question is treated without *parti pris* and with great soundness of independent judgment.

8. Conclusion. Every year Niagara falls are receding. The process of this retrocession is such that it is impossible to formulate any precise forecast as to its future rate and direction outside of generalities, all is more or less problematic.

This phenomenon is liable to many variations, owing to possible changes in the physical consistency of the geological beds over which the water descends. 'What will be the character of the channel which is now being formed,' says Mr. Grabau, 'can only be a matter of conjecture.'

At all events, I do not think the Canadian waters are, for long years to come, apt to suffer greatly from the retreat of the falls, whatever be its direction.

During the recedence of the Horseshoe towards the upper sill of the rapids, everything leads me to believe that the Canadian side will always have its great share of the hydraulic force of the river.

Once the falls have reached the upper ledge of the rapids in many hundreds of years (1,000 years, according to Grabau), assuming that the mean rate of retreat remain constant, which is far from certain, the retreat of the cataract will enter into a phase of relative rest, and the erosion will henceforth hardly take any other form than the wearing out of the lips of the new gorge, particularly that of the Canadian side.

The American channel will have then long disappeared, and the intakes of the Canadian works, after having gradually become impoverished as the line of the fall is rectified and identified with the sill of the upper rapids, will end by being dry.

The fall will then be at the first sills of the rapids. It will be higher than the present cataract by some fifty feet, and will noticeably resemble the drawing which

* Loc-cit., p. 500.

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Father Hennepin left us of that which he saw in 1673, when the Horseshoe did not exist, and the American and the Canadian falls were on one plain. The only difference will be that the fall will then be single, Goat isand having joined the American shore

Any one desirous of knowing in how many years the falls will reach that point should study the figures of Mr. Grabau, quoted above. Perhaps it is more prudent to simply say with Dr. Clarke, that these estimates of geological chronology express interesting possibilities, but hardly rise to the dignity of probabilities.*

Mr. Grabau,† himself, after having reproduced the figures which, according to C. H. Hitchcock, G. F. Wright, Spencer, Taylor, Pohlman and Lyell, give the geological age of Niagara, very wisely concluded by the statement that such figures are hardly more than the expression of personal opinions, and that they exclusively reflect the ideas which these writers have formed as to the rapidity of the erosion caused by the river. And he adds that there may be a reverse of causes still unknown which may have contributed, in a large measure, to lengthen or shorten this period. These causes, once known, will probably entail the revising of all calculations and will, no doubt, lead to different results.

In continuation of this thesis, it might be said that the factors yet undiscovered will possibly considerably modify all that has already been thought and written on the retreat of the falls in particular. I believe there are few scientific problems in which the personal equation plays so great a part. This is why the present report, while being little more than a summary of the principal works on Niagara, contains such a small proportion of the figures and calculations so abundant in the numerous monographs written on the subject.

(Signed) J. C. K. LAFLAMME.

QUEBEC, November 9, 1905.

‘ APPENDIX ‘ W.’

DEPARTMENT OF STATE,

WASHINGTON, January 25, 1905.

MY DEAR MR. AMBASSADOR,—With reference to your note of the 3rd inst., asking that a scheme for diverting the waters tributary to the international water boundary system by the Minnesota Canal and Power Company, of Duluth, Minnesota, be not carried out, pending the meeting of the International Water Boundary Commission, I take pleasure in informing you that I have received a letter dated the 19th instant, from the Secretary of the Interior, stating that his department had directed the Commissioner of the General Office, before whom the application of the said company is pending, to suspend further action in the case, until advised as to the results of the international boundary inquiry.

I am, etc.,

(Signed) FRANCIS B. LOOMIS.

HIS EXCELLENCY THE RIGHT HONOURABLE SIR H. M. DURAND, G.C.M.G.

APPENDIX ‘ X.’

EXTRACT from a Report of the Committee of the Honourable the Privy Council, approved by the Governor General on September 19, 1905.

On a report dated August 11, 1905, from the Minister of Public Works, stating that in January, 1905, Mr. Edward Wellington Backus, of Minneapolis, made an ap-

* Loc-cit, p. 489.

† Loc-cit. p. 85.

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plication for himself and those associated with him under chapter 92 of the Revised Statutes of Canada, for the right to construct a power dam across the Rainy river from a point in the town plot of Alberton, now the town of Fort Francis, to a point in the State of Minnesota, United States, opposite the said town of Fort Francis.

The Minister further states that with this application were also transmitted to the Department of Public Works plans showing the nature of the work to be performed, one being a sketch showing the location, and the other showing details of the mode of construction of the work.

The Minister further states that on January 19, 1905, the said E. W. Backus made with the government of the province of Ontario a certain agreement whereby the applicants obtained from the government of the said province a grant in fee of lands and power on the Canadian side of the international boundary for the purpose of developing the water power there and utilizing storage facilities with a view of creating a large amount of power for the operation of mills and other manufacturing establishments, the consideration of such acquisition being stated in the agreement at \$5,000; the agreement in question containing several conditions as regards the character and dimensions of the works; the raising and maintaining of the waters of Rainy lake; the use or non-use of flash-boards; the construction of power-houses; the expenditure of \$50,000 on the works within nine months from the date of the agreement; the delivery of power to the town of Fort Francis after January 1, 1907, for municipal purposes and for public utilities; the operation and delivery of said power; the rate at which it shall be furnished; the intervention of the Lieutenant Governor in Council concerning the price of the power or energy to be created, and several other agreements of different kinds always bearing upon the delivery and price of the energy to be manufactured out of the works approved by the agreement.

That the agreement also, in clause 14 thereof, reserves and excepts all the rights of the Dominion of Canada in navigation and the improvement thereof by the construction of locks, dams, canals, and otherwise, the government of the Dominion or the province of Ontario to have the power to enter upon the premises and maintain and repair such canals, locks, dams or other works for the improvement of navigation without compensation. It is also agreed that no sawdust, chemical or other refuse of any kind shall be placed or deposited in the river, etc.

That the application so made by Mr. E. W. Backus, on behalf of the Ontario and Minnesota Power Company, was referred to the Chief Engineer of the Department of Public Works for report, and that the officer in question stated that in so far as the construction of the dam is concerned, it would in no way interfere with navigation above or below the falls of Fort Francis, but would, in fact, be an improvement; that the dangerous rapids two miles above Fort Francis would be flooded, thereby improving materially the navigation; that the freshet waters stored in Rainy lake could be let out during the season of low water, thereby also considerably improving the navigation of the river between Fort Francis and Lake of the Woods; and that the only objection that could be raised to the proposed elevation of the dam is provided for by a proposed revetment wall to be constructed by the company, and also by a clause in the Act of incorporation of the Company, which makes all damages to lands caused by their works a charge to be borne by them. The Resident Engineer quotes the opinion of the Chief Engineer of the United States army, who says that the height of the dam appears to him unobjectionable, provided that the said dam is operated so as not to reduce the flow of Rainy lake during the low water season.

That in addition to the report obtained from the Engineer of the Department of Public Works the matter was referred to the Department of Justice, and that it reported that, in so far as the Dominion government was interested in the proposed works it had to consider them in so far as they affected the navigation and in so far as they affected the fishing, and also in so far as they could affect an unfinished canal and lock at the place where the dam is to be erected.

That at the session of parliament just closed, the Ontario and Minnesota Power Company have obtained an Act by which that company are authorized to construct

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and operate a water-power now existing at Fort Francis and build all necessary works for that purpose, provided no work so authorized shall be commenced until plans thereof shall have been submitted to and approved by the Governor General in Council. The Act in question contains several clauses referring to the production of power or electrical energy, the delivery thereof, the construction of power-houses, etc., the settlement of the price for power by the Board of Railway Commissioners, a clause is also inserted to prevent the diversion of that energy for use in the United States without an order of the said Railway Commissioners, the board having full jurisdiction to inquire into the matter as often as necessary, and to prescribe any action on the part of the company not inconsistent with the Act passed, etc.

That on communication with them on the matter, the Department of Marine and Fisheries have sent to the Department of Public Works a plan of the fishway which they think should be erected by the company in connection with their works, the said fishway to be built subject to the inspection and approval of an officer of the Department of Marine and Fisheries.

The Minister recommends, in view of the above application of the Ontario & Minnesota Power Company; of this agreement with the government of the province of Ontario, a copy of which is hereto annexed; of the Act passed by the parliament at its last session, and of the reports made by the Chief Engineer of the Department of Public Works, and the report of the Department of Justice, that authority be given to approve of the plans submitted by the said company, subject to the following conditions, viz. :—

1st. That the company shall not, in the execution of their works, construct them in such a manner that they will in any way interfere with the navigation of the Rainy river either above or below the point where the works are to be constructed at any time during the season of navigation, and that they shall not increase the height of water either by the construction of the dam itself or by placing flash-boards upon the said dam in such a way as to reduce the natural depth of water below said dam, nor generally will they interfere in any way detrimental to the said navigation.

2nd. That at any time during the construction of the works, or after their construction or during their operation, the Minister of Public Works shall have the power, when it shall appear to him necessary after a proper examination, to regulate the retention or flow of water by or over the dam; to enter on the works for such investigation, and also to have the right to make such regulations and issue such instructions as may, to the said Minister, appear advisable and necessary in the interest of navigation.

3rd. That the permission be granted subject to the conditions inserted in the agreement between the government of the province of Ontario and the applicants, and also subject to all the conditions and reservations expressed in the Act of Parliament passed at its last session respecting the Ontario & Minnesota Power Company, Limited.

4th. That no work will be done under the permission to be given to the Company which will in any way interfere with the lock, canal or other works of public nature already executed at Fort Francis by the government of Canada, nor will any bridge or any other erection or construction of any nature whatsoever on, over or across said lock, canal or other works, be built, nor generally shall any use be made thereof, except by permission in writing given to that effect by the Minister of Public Works.

5th. That no work for the construction of any dyke or retaining wall provided on the plans submitted by the company shall be commenced until the detailed plans thereof shall have been submitted and approved of by the Minister of Public Works,

6th. That should it appear necessary to the Minister of Public Works during the course of construction of the works hereunder to be authorized to cause said works to be interrupted for any changes, alterations, etc., as to him may appear advisable, then the company will immediately cause the said works to be stopped forthwith, and will carry out any alterations or changes which may be ordered by the said Minister, and will conform in every way to the directions of the said Minister.

7th. That the company shall provide in the execution of their works for the construction of the necessary fishway upon a plan and in a manner approved by the

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Department of Marine and Fisheries, the officers of that department to have, for that purpose, the right of entering upon the work and seeing to the proper construction of the said fishway in accordance with whatever plans and specifications they may prepare.

The committee submit the same for approval.

(Signed) JOHN J. McGEE,
Clerk of the Privy Council.

APPENDIX 'Y.'

EXTRACT from a report of the Committee of the Honourable the Privy Council, approved by the Governor General on November 21, 1905.

The committee, on the recommendation of the Minister of Public Works, advise that, in view of the appointment of Mr. J. P. Mabey as one of the Justices of the High Court of Ontario, Mr. George C. Gibbons, K.C., be in his place appointed chairman of the Canadian section of the International Waterways Commission.

(Signed) JOHN J. McGEE,
Clerk of the Privy Council.

APPENDIX 'Z.'

DETAIL REPORT OF THE SUB-COMMITTEE MENTIONED AT PAGE 9.

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21. The Detroit river and Lime Kiln crossing.

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DETAILED relation of an investigation made by a sub-committee of the International Waterways Commission, through the lakes and rivers connecting the same, including a visit to Sault Ste. Marie, Port Arthur, Fort William, Duluth, Chicago, Detroit &c.

A committee, composed of Mr. James P. Mabee, chairman of the Canadian section, Mr. George Clinton, member of the American section, and the writer, Secretary of the Canadian section, proceeded to Sault Ste. Marie, on August 12, 1905, to investigate and report upon the uses of the waters of St. Marys river, as set forth in the Act of Congress, approved on April 13, 1902. In section 1, page 35, the duties of the International Waterways Commission, in regard to the matters at the Soo, are described as follows:—

‘Subject to the express precedent conditions hereinafter mentioned, the Michigan Lake Superior Power Company, of Sault Ste. Marie, Michigan, its successors and assigns, after first obtaining consent of the Secretary of War and the Chief of Engineers, and their approval of the said canal and remedial works proposed, is hereby authorized to divert water from the St. Marys river into its water-power canal now being constructed at Sault Ste. Marie, Michigan, for water-power purposes, while and so long as such works and diversion of water from said river shall not injuriously affect navigation therein, nor impair or diminish the water levels or any natural increase thereof, either in Lake Superior or in the United States ship canals and locks or the navigable channels, locks, or ship canals connected therewith, whether natural or artificial, now existing or which may hereafter be established or created by the United States for navigation purposes; and conditioned further, that said company shall establish, maintain and operate suitable and sufficient remedial and controlling works in the rapids of said river, to the approval of the Secretary of War and the Chief of Engineers; and said company shall maintain and operate said canal and works in accordance with any rules and regulations that may hereafter be recommended by any international commission and that shall become operative. Whenever, in the judgment of the Secretary of War, the operation of said canal and remedial and controlling works, or either of them, either in themselves or in conjunction with any other canal or canals in the United States or Canada which now, or hereafter may, exist, is injuriously affecting water levels or the navigation of Lake Superior, the River St. Marys, or other channels, locks or ship canals connected therewith as hereinbefore provided, he shall impose upon said company such rules and regulations for the operation of said canal and remedial works, as may, in his opinion, be necessary to prevent such injury. It shall become his duty, and he shall have the authority to enter upon the property of said company and to close said canal in whole or in part to the extent necessary to maintain water levels and to require said company, at its own expense, to remove, add to or modify said works or any part thereof to the extent necessary to maintain water levels. Neither the Secretary of War nor the Chief of Engineers or any officer or other person acting under direction of them, or either of them, shall be in any way liable by reason of anything done in the execution of this provision.

‘All remedies herein provided, however, shall be cumulative, and shall be without prejudice to any other remedies either of the United States or of individuals for failure of the said company to maintain said levels for navigation purposes, as herein provided.

‘Nothing herein contained shall be held to affect any existing riparian or other rights of any person or corporation, or the existing remedies therefor, or any action at law or equity now pending. The right is hereby expressly reserved to Congress to alter, amend or repeal the provisions contained in this paragraph.’

Mr. George Clinton went by way of Owen Sound, taking the Canadian Pacific Railway Company's steamer *Alberta*, and arrived at Sault Ste. Marie, Michigan, on Sunday, August 13.

Mr. James P. Mabee and the writer proceeded to Port Huron, Michigan, to in-

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investigate the conditions and the uses of the waters of St. Clair river and Lake St. Clair. The start was made from Port Huron, Michigan, the visitors proceeding east.

1. THE RIVER ST. CLAIR.

The St. Clair river has two different sections—the upper or undivided channel, and the lower portion. The undivided channel runs from Lake Huron to the head of Chenal Ecarte, a distance by steamer track of about 27 miles. At this point the river begins to divide into a number of channels. The one used by vessels is called the 'South Channel,' and its length, from the head of Chenal Ecarte to the southwest end of St. Clair Flats canal, is about 13 miles, making the total length of the steamboat track, from Lake Huron to Lake St. Clair, about 40 miles.

The discharge through the upper or undivided portion of the river is 206,400 cubic feet per second, when Lake Huron is at a stage of 581.40 feet above mean tide at New York. The increase of discharge per foot rise of the lake is approximately, according to the engineers of the United States Army, 19,238 cubic feet per second. The river leaves Lake Huron with a velocity, opposite Fort Gratiot, of about 5 miles an hour, and enters Lake St. Clair, through the canal, with a velocity of about $1\frac{1}{4}$ miles an hour. At intermediate points the velocity varies irregularly between these limits. The banks of the river are clay and sand and usually quite steep; there are no rocks. There are two islands in the upper portion of the river: Stag island and Woodtick island.

Extensive dredging works have been performed by the Canadian Department of Public Works at Sarnia, in front of the Grand Trunk Railway wharf and the Lake Erie ferry slip. This has been done, as Sarnia is one of the principal harbours of the Grand Trunk Railway system and a stopping place for all Canadian passenger steamers passing through the St. Clair river. From the foot of George street, $3\frac{1}{2}$ to 5 fathoms can be carried close to the shore in front of and below the Grand Trunk depot and continuing down to Fromefield. A bay with shallow water extends from the foot of George street up to Point Edward. The anchorage at the head of St. Clair river below the rapids and abreast of Port Huron and Sarnia is good in clay and gravel. In the rapids and abreast of Point Edward it is rocky and bad. Good holding ground and some clay are to be found on the Canadian shore below the Grand Trunk elevator. Vessels generally anchor as close to each shore as safety permits, to leave the mid-channel clear for passing vessels. Fixed red range lights at Point Edward lead into the head of the St. Claire river from Lake Huron. The front light is on the beach 107 feet back from the water edge, and is visible eight miles from all points of approach by water. The rear light is 579 feet south of the front light and visible $9\frac{1}{4}$ miles in the line of range. This range is followed by vessels until intersected by the Fort Gratiot range, on the United States side of the river.

The Port Huron rapids are about two miles above the town of the same name. The velocity of the current at this point is about 5 miles per hour. Two range lights on the American side, one mile below Fort Gratiot light, mark the sailing line through these rapids. There is good holding ground in clay or gravel bottom between Port Huron and Sarnia. The shoal at the mouth of Black river is marked by two buoys, a gas buoy about midway between the mouth of the river and the Canadian side, and a black spar buoy about 2,000 feet below the gas buoy. Between these buoys and the Canadian side there is a channel with a minimum width of 1,000 feet, and a depth of 21 feet at a stage of 581.5 feet above mean tide at New York. Between the buoys and the American side there is a depth of 14.5 feet at the above stage. This shoal is not quite stable, but is, on the contrary, increasing at a slow rate. It will be perceptible in two or three years. The channel in Black river has a depth of 15 feet up to the Grand Trunk Railway bridge. At Stag island, the American channel has a depth of 21 feet, at a stage of 577.5 feet above mean tide at New York, and a minimum width of 900 feet. The Canadian channel has a minimum width of 550 feet and a depth of 28 feet at the above stage. A crib marks the lower entrance, and two range

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lights mark the upper entrance to this channel. At Corunna, opposite Stag island channel, the Canadian channel is in the best order. There are range lights to guide through good water past the shoals at the head of Stag island, and also past the shoals at the mouth of Talford creek, which coming from the Indian reservation, in the county of Lambton, Ontario, flows through Fromefield into the river, right opposite Marysville, Michigan.

Mooretown and Courtright, Ontario, which are just $1\frac{1}{2}$ miles apart, were visited. The Lake Erie and Detroit River Railroad runs through the village of Mooretown. There are two wharfs with about 16 feet of water. Baby's creek enters St. Clair river about one-third mile below the village. At Courtright, opposite the town of St. Clair, Michigan, there is good water along the wharfs with depths of 15 to 20 feet. At St. Clair, Michigan, the American channel has a minimum width of 800 feet and a depth of 21 feet at a stage of 577:0 feet above mean tide at New York. The Canadian channel has a depth of 26 feet at the above stage, with a minimum width of about 800 feet. Pine river empties into St. Clair river at St. Clair, Michigan. The original depth of that river over the bars was 5 to 8 feet. In 1897 the channel from the mouth of the river to the shipyard was dredged to a depth of 14 feet, and in 1899 further dredging was done from the shipyard to Belknap's brickyard to a depth of 12 feet. The present available depth in these two channels is 13 and 11 feet respectively. The shoal or middle ground between the American and Canadian channels, between St. Clair, Michigan, and Courtright, Ontario, is marked by two gas buoys, one at the upper and one at the lower end.

At Sombra, Ontario, opposite Marine City, Michigan, there are two wharfs, one-third mile apart, extending about 200 yards in shallow water to 13 feet at the outer ends. At this particular point the channel on the American side is straighter and wider and therefore, more frequently used than the Canadian channel.

At Marine City, Michigan, the United States government had dredged in 1897, at the mouth of the river to the first bridge, a channel 75 feet wide and 15 feet deep. In 1899 the channel was dredged to Broadway bridge, to a width of 75 feet and a depth of 14 feet.

The vessel route at the mouth of St. Clair river is through the boundary line channel. The United States government at this point has expended large sums of money in improving the channel by driving piles and dredging between them. The greater portion of the improvements were made on the United States side of the line; but some of them were also made in Canadian waters, and inasmuch as the improved channel has completely obliterated the natural one, it follows that the improved channel, regardless of its alignment, is and has always been considered a common channel to Canada and to the United States. From the St. Clair flats to Lake Huron the route follows the boundary line, except when passing Woodtick island and Stag island, where it is in United States waters, yet, there is also a good channel in Canadian waters past the islands just named.

A short distance from Marine City, Michigan, and Sombra, Ontario, is Woodtick island, and a little farther east the village of Port Lambton, Ontario.

Past the Chenal Ecarte there is the village of Algonac, Michigan, opposite Russel island, at the head of the north channel. This north channel, opposite Pointe aux Trembles, Michigan, divides into two sections, one flowing through Chenal a Bout Rond into Goose bay, the other flowing into Anchor bay.

Opposite Grand Point, on Herson island, in the south channel, the wreck of the steamship *Minnesota*, which was burnt and sunk in October, 1903, close to Squirrel island, had been removed during the latter part of 1904, and in 1905 it was ascertained that there is at this particular site a depth of 25 feet of water.

Between Walpole island and Squirrel island there is the Canadian blind channel, which is used only by local and small craft, the average depth of water in the channel not exceeding eight or nine feet.

On the left side of Squirrel island there is also the Basset channel, which is scarcely used except by small vessels.

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Between Herson island and Dickenson's island lies the middle channel, which flows from the north channel into the Big Muscamoot bay.

2. THE ST. CLAIR FLATS CANAL AND LAKE ST. CLAIR.

It will, therefore, be seen that originally the St. Clair river emptied into Lake St. Clair through several principal mouths or passes, the channels originally used being the north channel, the middle and the south passes. While each of these mouths or passes, constituting the delta known as the St. Clair flats, afforded good water, especially the north, middle and south passes, yet all were obstructed by sandy deposits forming bars in the lake.

The improvement of a channel through these flats has been the subject of discussion ever since the upper lake region had any commerce to speak of. A survey of the locality was made as early as 1841, and in 1852 the United States Congress made an appropriation of \$20,000 for plans and examinations, having in view the improvement of the south pass. But it was only in 1855 that the work of improving the navigation of the St. Clair river at the 'Flats' was actually commenced under the direction of the Buffalo Board of Trade. The funds were obtained by subscriptions from the United States lake ports interested in the lake trade. The project was to dredge a channel 60 feet wide and 12 feet deep in the middle channel of the south pass, $1\frac{1}{2}$ miles west of the boundary line route now in use.

In 1857, under a United States appropriation of \$50,000, the improvement was continued on the same line, and in 1858, the Canadian government contributed towards the still further improvement on the same line, which sum was expended under the direction of the Buffalo Board of Trade, under arrangements approved by the Canadian government. One of the conditions was that the money would not be spent until a channel of 125 feet wide and 12 feet deep had been first excavated by the United States, which was done. This channel was found to be difficult to maintain and navigate. The present St. Clair Flats canal was projected in 1866 by Colonel Cram, of the United States Army Corps of Engineers.

The first plan provided for a straight channel, 13 feet deep and 30 feet wide, across the Flats east of the mouth of the old channel. This was completed in 1871. The canal was protected on either side by a dike 7,227 feet long, making an aggregate of 14,452 feet of timber cribs resting upon piles driven into the original bottom of the shoal. A lighthouse was installed at each end of the eastern pier.

In 1873 the channel was deepened to 16 feet by dredging for a width of 100 feet on either side of the axis of the canal, or a width of 200 feet in all. This was done on account of the fact that the single row of sheet piles intended by the project of Colonel Cram, in 1866, for a depth of 13 feet, had not sufficient penetration to admit dredging to 16 feet for the full width of the canal.

In 1886, another plan of improving the channel was adopted. It consisted in driving a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet. The channel above and below the canal was to be dredged to the same depth in the river and in the lake. But, subsequently, it was considered sufficient to obtain a depth of 18 feet. This work was completed in June, 1892. The pile revetment along the channel face of each dike was then finished, and a channel of 18 feet deep from about 900 feet above the canal in St. Clair river to about 3,300 feet below the canal was available. This depth of 18 feet was obtained for the full width of the canal, viz.: 300 feet or more for its full length. At the lower end of the canal, the 18 feet deep channel gradually widened to a width of 380 feet, at a distance of 300 feet below the canal. From that point to a farther distance of 3,300 feet below the canal, the channel had a uniform width of 380 feet.

In 1891, the late Colonel O. E. Poe, of the Corps of Engineers of the United States Army, submitted an estimate for a channel of 20 feet deep, extending from a point about 1,500 feet above the canal, then through the canal and thence to about

10,000 feet into Lake St. Clair, with a width of 600 feet at its lower end. This plan was adopted and embodied in an Act of Congress of July 13, 1892.

The work was commenced in April, 1893, and completed in December, 1894, at a cost of \$107,024. At the time, the dikes of St. Clair Flats canal were 7,221 feet long each, and the channel faces were riveted with double rows of sheet piling 26 feet deep, and the backs of the dikes were protected against the action of the waves by shorter sheeting. The canal had a clear width of 295 feet between the dikes, and a depth of 20 feet. The channel had also a depth of 20 feet from deep water in St. Clair river to deep water in Lake St. Clair, with a width above the canal of 650 feet, thence gradually narrowing to the canal; thence having the full width of the canal over its entire length; thence gradually widening to a width of 800 feet at deep water in Lake Erie.

The cost of the improvement of the St. Clair Flats canal, from the beginning in 1852 to 1896, is \$809,859.06, divided as follows :—

Cost of North Channel of South Pass, 1852 to 1858.. . . .	\$ 64,829 01
Cost of South Channel of South Pass, 1858 to 1895, for completing project of 1868, channel 13 feet deep, single sheet piling.....	461,090 01
For completing project of 1892, including repairs to July 1, 1881.....	115,933 53
For completing project of 1886, channel 18 feet deep, second row sheet piling.. . . .	168,007 51
Total cost.....	\$809,859 06

In 1902, the United States Congress authorized the construction of a second channel, similar to the one already in use and parallel to it, but separated therefrom by a dike of about 100 feet wide, so as to provide a channel of 20 feet minimum depth and about 300 feet wide, from Lake St. Clair up into St. Clair river, for ascending boats, and a similar channel for descending vessels.

The work was started in 1904 and was in way of being completed during the summer of 1905. The appropriation made by the United States Congress for this improvement is \$330,000, making total appropriation for the St. Clair Flats canal, from 1866 to 1903, \$1,094,810. With the amounts spent in 1852 and 1856, by the United States and the Canadian governments, it makes a total expenditure of \$1,149,810, incurred in this undertaking.

The St. Clair Flats ship canals, en resume, comprise the dikes, the water between the dikes, and the improved channels of approach, both above and below the dikes. The improved approach above the dikes is 800 feet long; that below the dikes 11,000 feet long, and the dikes themselves are 7,221 feet long, making the total length of canal of about 19,000 feet.

The canal is marked by two lighthouses and two gas buoys. The lighthouses show the range of both the upper and lower approaches. The gas buoys are about one mile below the dikes and mark the east and west sides of the lower approach.

The width between the dikes and the width of the upper approach is 292 feet. The width of the lower approach is 400 feet. The depth at a stage of 575.0 feet above mean tide at New York is 24 feet. During the lowest water of the season of 1904, a draught of 19 feet could be carried through this channel.

Some years ago there was a dispute as to whether the St. Clair Flats canal was in Canadian waters or in the waters under the jurisdiction of the United States government. Investigation and reports were made on this subject by the Corps of Engineers of the United States Army, and by engineers engaged by the Canadian government. The reports did not agree. But there is no doubt that part of the St. Clair Flats canal is in Canadian territory, and that this improved water communication now in general use across the St. Clair Flats, is more or less on the boundary line between Canada and the United States. As such, this water communication is com-

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mon to the trade of the lakes of both countries. Article XXVII. of the Treaty of Washington, 1871, states that the 'subjects of Her Britannic Majesty shall enjoy the use of the St. Clair Flats canal on terms of equality with the inhabitants of the United States.'

From the southwest end of the St. Clair Flats canal to Windmill Point lighthouse in Detroit river, the steamer track has a length of 17 miles. The area of the water surface of Lake St. Clair is 4,450 square miles. According to the United States Weather Bureau, the average annual rainfall in Lake St. Clair is 36 inches. The average date of opening of navigation at St. Clair Flats lighthouse is April 4, and the average date of closing of navigation at the same place is December 15.

After a short visit to Detroit and Windsor, the members of the sub-committee returned to Port Huron by the Detroit river and Port Huron Electric Railway.

3. LAKE HURON.

The members of the sub-committee left Monday afternoon, August 14, on the steamship *Monarch*, of the Northwestern Navigation Company, for Sault Ste. Marie, crossing Lake Huron from Sarnia to Detour in little less than twenty-two hours. The distance between Point Edward, Ontario, opposite Fort Gratiot, Michigan, to Detour passage is 220 miles. The steamer track from Fort Gratiot, Michigan, to the Straits of Mackinac is 243 miles. From Point Harris to Drummond island, in a right line, the distance is 206 miles. The maximum depth recorded is 750 feet. Lake Huron has an area of water surface of 23,200 square miles. Its drained area is 52,100 square miles, making a total area of its basin of 75,300 square miles. The average annual rainfall in Lake Huron is 32 inches. Its mean surface above mean tide at New York city, during 45 years, from 1860 to 1904, is 581.40 feet. The standard high water, established in 1838, above the mean tide at New York city, is 584.69 feet, and the standard low water above mean tide at New York city, said standard being adopted for new charts, is 578.51 feet. The mean surface of Lake Huron below the mean surface of Lake Superior is 20.89 feet, and its mean surface above mean surface of Lake Erie is 8.79 feet, the discharge of St. Clair river at the mean stage of Lake Huron (581.40 feet) is 206,400 cubic feet per second. The increase in discharge per foot rise of the lake is 19,238 cubic feet per second. The average date of opening of navigation at Sarnia, or Point Edward, is April 6, and the average date of closing of navigation at the same point is December 19.

Around Lake Huron on the Canadian side, there are storm-warning stations at the following places: Amherstburg, Bayfield, Collingwood, Depot Harbour, Goderich, Kincardine, Midland, Owen Sound, Parry Sound, Presque Isle, Sarnia, Saugeen and Tobermory. There are also life-saving stations at Collingwood and Goderich. On the American shore we find life-saving stations at Bois Blanc Island, Grindstone City, Hammond Bay, Lakeview Beach, Middle Island, Ottawa Point, Pointe aux Barques, Sand Beach, Sturgeon Point, Tawas Point and Thunder Bay Island.

The United States Weather Bureau has established storm-warning display stations at the following places, on the American coast of Lake Huron: Alpena, Bay City, Cheboygan, Detour (at the outlet of St. Marys river), Detroit, East Tawas, Harbour Beach, Lakeview Beach, Mackinac Island, Mackinaw, Middle Island, Oscoda, Ottawa Point, Pointe aux Barques, Port Huron, Presque Isle, Tawas Point and Thunder Bay Island.

4. ST. MARYS RIVER.

The vessels enter St. Marys river from Lake Huron, at Detour passage at a point $1\frac{1}{2}$ miles from the lighthouse of Point Detour. They thence proceed north in a straight line for a distance of three-quarters of a mile up to Frying Pan lighthouse. At this point they turn a little to the left and proceed again in a straight line for a distance of $1\frac{1}{2}$ miles to Pipe Island lighthouse, which is situated at the southeastern end of Potagannissing bay, where they turn farther to the left. From Sweet's point the

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vessels again turn a little farther to the left and proceed in a straight line for a distance of $2\frac{1}{2}$ miles to Sweet's Point light. Off Sweet's island, from Sweet's Point light, they proceed for a distance of $4\frac{1}{2}$ miles, passing at a short distance off Lime island up to a point opposite Raber Point, Michigan, thence turning straight north and passing to the right of Round island, opposite Hay Point, Ontario, and Pointe aux Frenes, Michigan, covering a distance of 4 miles.

From Hay Point the vessels enter the Mud Lake channel. After a distance of $6\frac{3}{4}$ miles they reach the Mud Lake beacon, opposite Winter point, on the east end of Neebish island, thence for a distance of 4 miles they proceed north, up to the Sailors' Encampment channel, thence they reach Little Mud Lake channel, the Middle Neebish channel and the Hay Lake channel, passing to the left of Middle Hay Lake front light, and to the right of Frechette point, thence through the Little Rapids channel up to the Soo.

Navigation around the rapids of Sault Ste. Marie is provided for by two canals; one on the United States side and one on the Canadian side. Between the canal and the lighthouse at the entrance of Hay Lake channel, the United States government, during the season of 1905, has removed the Bayfield and other adjacent shoals to the extent of securing a channel of 21 feet deep and 1,500 feet wide. At the head of Sugar island, about 2 miles below the canal locks at Sault Ste. Marie, the channel divides in two. The old line of travel known as the Lake George route, passes to the northward and eastward of Sugar island through Lake George and East Neebish. The new line, known as the Hay Lake route, passes to the west of Sugar island through Hay lake and Middle Neebish. The two routes reunite at the head of Little Mud lake. The distance from Point Iroquois to Detour by the Hay Lake route is 64 miles, and by the Lake George route 75 miles. The least width of the channel by way of Hay lake is 300 feet, limited to a total distance of 8 miles. The general width of the channel is 600 feet or more, and the least depth at the present prevailing stage of water is about 19 feet. The least width of the channel by way of Lake George is 150 feet, and the least depth about 15 feet. Both roadsteads are well defined by numerous buoys and by the mid-channel ranges.

There is another important channel known as the St. Joseph channel, with least depth of 13 feet, which leaves the Lake George and Hay lake channel near their junction at the south end of Sugar island, and passing to the northward and eastward of St. Joseph island, leads into Manitoulin bay or north channel, thence to Georgian bay by way of Clapperton Main passage and Little Current, or directly into Lake Huron through channels on the east and west sides of Cockburn island, called, respectively, the Nississagi strait and False Detour channel. These channels are all in Canadian waters.

From Detour passage to Sault Ste. Marie, parts of Lake George channel from Little Rapids to the foot of Sugar island are in Canadian waters. The upper part of the channel in Little Mud lake and east channel at Sailors' Encampment, and part of the angle of the west channel, are also in Canadian waters. The United States engineers in charge of the Public Works Department of the War Office at Sault Ste. Marie, claim that the above improvements were made with the tacit consent of the Canadian government. Lake George channel was made from 1869 to 1882. Little Mud lake was dredged from 1892 to 1894 at a cost of \$23,000. Sailors' Encampment channel was commenced in 1882 and finished in 1895 at a cost of \$23,000. Further improvements in that channel were made from 1903 to 1905, at a cost of \$11,000. Further improvements at the head of Sailors' Encampment were being made by the removal of boulders, sand and rock, from an area of 1,400 feet long and 200 feet wide on the west side of the channel just above Johnson's point, and on the east side of the channel by the removal of sunken cribs and boulder ridges covering an area of 1,800 square yards. This important work has been proceeded with during the whole summer. At the foot of Little Mud lake the angle in the channel was widened last year on the east side by the removal of 49,033 cubic yards of sand and boulders from an area of

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about 15,700 square yards, and on the west by the removal of 3,941 cubic yards from an area of 2,400 square yards.

The improvement of Hay lake and Neebish channel was commenced in 1893 and opened to navigation in 1894. The result was a new line of travel through St. Marys river, 11 miles shorter and 4 feet deeper than that previously available, and one which can be navigated at night with a reasonable degree of safety. In 1902 a project was adopted providing for a channel of 21 feet available depth at low water and 1,000 feet width from St. Marys Fall canal to the foot of Hay lake, thence deepening to 21 feet the present 300 foot channel to Mud lake, via Middle Neebish, and opening a new 300 foot channel to Mud lake, via West Neebish, thus providing separate channels through this stretch for up and down bound boats.

In 1904, the United States government, in Hay lake channel, spent \$2,738,081.39, and during the present season of navigation a further expenditure of \$1,221,033.61 was incurred. Below the islands, at Little rapids, the channel has been improved for a distance of 10,200 feet by widening on the east side 150 feet to a depth of 21 feet. The channel through the Little rapids section of the upper entrance to Hay lake is, therefore, at present 600 feet wide. The deepening to 21 feet through Little rapids was completed in 1904, from the head of the islands to Frechette point. The deepening from Frechette point to Six Mile point was in progress during the summer of 1905.

The deepening of Nine Mile point shoal to 22 feet was commenced in 1904 and was finished in August, 1905.

A very large boulder shoal with at least a depth of 12 feet over it, called Crab Island shoal, lies in 23 feet of water near the western end of the shoal, about half a mile southwest of Barbed point and about 1,000 feet east of the usual course of vessels through Detour passage. There are a number of boulders in the vicinity with less than 20 feet over them. A red spar buoy marks the most westerly boulders of Crab island. A derrick-boat and diving outfit have been employed during midsummer of 1905 in removing the boulders from the west end of this shoal.

The sub-committee arrived at Sault Ste. Marie, Ontario, on Tuesday afternoon, August 15. They were met at the Canadian government dock by Mr. George Clinton and Mr. Lochlan P. Morrison, junior assistant engineer of the River Improvements office, who, in the absence of Lieut.-Col. Chas. E. L. B. Davis, of the Corps of Engineers of the United States army, in charge of the district, had been directed to receive the committee officially. The members of the committee immediately embarked on the United States government steamer *Alfred Noble*, and crossing the river they proceeded at once to visit the power canal and the plants of the Michigan Lake Superior Power Company, being accompanied by Mr. Louis H. Davis, Chief Engineer of the Consolidated Lake Superior Power Company.

5. THE MICHIGAN LAKE SUPERIOR POWER COMPANY.

Was incorporated in virtue of the Act No. 39 of the Public Acts of the State of Michigan, 1883. This Act, with the amendments thereto, is the legal authority for the Michigan Lake Superior Power Company to do business in the state of Michigan. The congress of the United States in 1902, by an Act approved on June 13, making appropriation for the construction, repairs and preservation of certain public works on rivers and harbours and for other purposes, authorized the Michigan Lake Superior Power Company to build its canal on the American side, and after the approval of this Act, the United States War Department granted the company the following permit :—

‘Whereas, by the River and Harbour Act, approved June 13, 1902, it is provided (32 Stats., 361) that, subject to the conditions therein mentioned :

‘The Michigan Lake Superior Power Company of Sault Ste. Marie, Michigan, its successors and assigns, after first obtaining consent of the Secretary of War and the Chief of Engineers, and their approval of said canal and remedial works proposed, is hereby authorized to divert water from the St. Marys river into its water-power

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canal, now being constructed at Sault Ste. Marie, Michigan, for water-power purposes, while and so long as said works do not affect navigation therein, nor impair or diminish the water levels or any natural increase thereof, either in Lake Superior or in the United States ship canal and locks, or the navigation channels, locks, or ship canals connected therewith, whether natural or artificial, now existing or which may hereafter be established or created by the United States for navigation purposes :

‘ And whereas, the said Michigan Lake Superior Power Company has submitted for approval of the Secretary of War and Chief of Engineers plans of its water-power canal and remedial works for the diversion of the water from the St. Marys river authorized by said Act, and has applied for consent of the Secretary of War and Chief of Engineers to such diversions :

‘ And whereas, the Chief of Engineers has approved the said plans, and has given his consent to such diversion, subject to the acceptance by said company of the conditions hereinafter specified :

‘ Now, therefore, this is to certify that the Secretary of War hereby approves the said plans, which are hereto attached, and hereby gives his consent to the diversion of water from the St. Marys river, as authorized by said Act, subject to the acceptance by said company on the following conditions :

‘ 1. That the regulating works, including escape valves at power-house, controlling works, and remedial works, shall be operated under the inspection of the engineer officer in charge of the St. Marys Falls canal, who shall have access to them at all times.

‘ 2. That when the mean level of Lake Superior at the canal for any calendar month falls below 601·5 feet above mean tide at New York, according to the levels of the United States Survey Office, the flow through the canal shall be reduced, the amount of reduction increasing as the monthly mean level falls until it reaches 601·0, when all flow shall be stopped until the monthly level again exceeds 601·0, all without claims against the United States, or against any officer thereof.

‘ 3. That in addition to the requirements of condition 2 (*supra*), all flow shall likewise be stopped, without claim against the United States, or against any officer thereof, should the monthly mean level of the lake remain below 601·5 for a period of six consecutive calendar months, and shall not be resumed until the monthly mean level shall exceed 601:5.

‘ 4. That when the monthly mean level raises above 603:0, the flow through the canal and the remedial works shall be increased to their maximum capacity, and shall so continue until the monthly mean level shall be less than 603:0 without claim against the United States, or against any officer thereof.

‘ 5. That should the monthly mean level of the lake remain above 603:0 for a period of six consecutive calendar months, said company shall alter its works at its own expense as soon as practicable, so as to allow more flow.

‘ 6. That the United States shall have the right to assume entire control of the flow of the water through the canal and remedial works in cases of accidents or emergencies temporarily affecting navigation through the United States ship canal.

‘ 7. That should cross currents, detrimental to navigation, be created by the intake or by the outflow of the canal, said company shall construct such booms, training walls, or other works, as may be necessary to remedy the evil.

‘ 8. That said company, in its arrangement and construction of remedial works, shall leave a suitable channel and water flow for the passage of logs over and through St. Marys falls.

‘ 9. That these limitations are in addition to the special limitations of the Act of June 13, 1905, regarding riparian or other rights of any person or corporation and the remedies therefor.

‘ 10. That the elevations above mean tide at New York, above specified, are those established and in use at this date by the Office of the Survey of the Northern and Northwestern Lakes, commonly known as the Lake Survey Office at Detroit, Michigan.

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'11. Finally, the object and claim of the foregoing paragraphs being to hold the waters of the lake and river under the absolute control of the United States in the interest of navigation, it is expressly understood that said company shall not be entitled to damages should the government at any time or for any cause exercise its right to control and suspend the flow of water through the power canal, in the interest of navigation.

'Witness my hand, this 12th day of December, 1902.

'(Signed) ELIHU ROOT,

'*Secretary of War.*

'This instrument is also executed by the Michigan Lake Superior Power Company by Francis H. Clergue, its president, thereunto lawfully authorized, this ninth day of December, 1902, in testimony of the acceptance by said company of the foregoing conditions.

'THE MICHIGAN LAKE SUPERIOR POWER COMPANY,

'BY FRANCIS H. CLERGUE,

'*President.*

'Attest:

'H. VON SCHON,

'F. T. TREMPER.

'(Seal)

'OFFICE, CHIEF OF ENGINEERS, December 2, 1902.

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'War Department.'

The plant of the Michigan Lake Superior Power Company has been designed to develop a portion of the power of the St. Marys rapids.

To accomplish this end, water is diverted from the St. Marys river above the rapids into a canal running through the city of Sault Ste. Marie to a power-house situated near the shore of St. Marys river, about 4,400 feet below the rapids, and is there returned to the river, after passing through turbines, which, together with electric generators, convert the hydraulic power into mechanical and electrical power. The plant is designed to develop about 45,000 horse-power at the turbine shafts, equivalent to about 42,000 electric horse-power at the switchboard in the power-house. Of this portion about 8,000 electric horse-power is now being utilized by the Union Carbide Company and Tran-Sault Ste. Marie Traction Company.

The plant consists of the canal, head gates, power-house and power-house equipment.

The canal consists of the intake, canal proper, fore-bay and tail-race. Its total length from the harbour line above the rapids to harbour line below the rapids is about 12,000 feet.

The head of the intake is located along the established United States harbour line, immediately west of the entrance to the United States ship canal, and its width along the harbour line is 990 feet, and its depth is 18 feet, so that the velocity of the water at the entrance will be, when the canal is operating at its full capacity, about $1\frac{2}{3}$ cubic feet per second. The intake as it continues easterly, gradually narrows to a width of 204 feet, and deepens to a depth of 23 feet, below mean still water level at a point about 1,500 feet from the centre line of the entrance, thence continuous at the width given for a distance of about 900 feet to the head-gates. The sides of the intake are retained by rock-filled timber cribs with slopes of riprap paving above the water line.

The canal proper begins at the head-gates, and for about 2,700 feet was excavated largely through sandstone bedrock to a width of about 200 feet, with substantially vertical walls. Where not excavated in rock the earth is retained by masonry retaining walls. Continuing east from the rock section, the canal extends for about 3,000 feet with rock bottom and timber-lined sides, and thence for another 3,000 feet through

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clay and sand, the bottom and sides both being timber-lined below the water line. The slopes above the water line are paved with riprap. At the end of the clay section, the canal widens into a forebay, which delivers the water to the turbine chambers or penstocks in the power-house. The water, after passing through the turbines into the tail pits, flows into the tail-race, the width of which is the full length of the power-house, 1,340 feet, and thence is discharged into the river with a velocity of less than $1\frac{1}{2}$ feet per second.

In the forebay are located steel racks which collect floating wood, ice and other objects, and these divert such material through a wooden channel into a spillway, passing through the power-house to the tail-race.

The power-house is 1,340 feet long by 80 feet wide. Its foundation is a grillage of timber filled with concrete, resting on piles driven to bed rock. The substructure is divided by concrete walls into 81 tail pits, each one of 80 of which receives water from a turbine chamber or penstock immediately above it. The upstream ends of these tail pits are closed by segmental concrete arches and the roofs of the tail pits are monolithic concrete arches, which form the penstock and dynamo room floors. The superstructure has stone and concrete masonry walls with floors of steel and concrete, supported by steel columns, and is covered by a steel roof. The forebay side consists of 80 penstocks and one spilling way opening. These penstocks contain the turbines. They are $16\frac{1}{2}$ feet, centre to centre, 15 feet in width clear, and are closed on the downstream side by semi-cylindrical steel bulkheads, attached to steel and concrete partition walls. The penstocks take up about one-half of the first floor space. The first floor of the river side of the power-house, which is just north of the penstocks, forms the dynamo room. The second and third floors in the power-house are arranged for the location of machinery for manufacturing plants which now use, or may use, power generated by the plant.

At the west end of the power-house is located a boiler plant of about 250 horsepower capacity with centrifugal pumps for pumping, in the event of necessary repairs to the canal or power-house, from the canal such water as will not drain by gravity into the tail-race.

The equipment of the power-house will be 80 penstock units, each consisting of two pairs of 33-inch horizontal turbines mounted on one shaft, which extends through the steel bulkheads into the dynamo room. To each turbine shaft there will be directly connected an electric generator of 375 to 400 K. W. capacity. There are at present installed 42 turbine units and 32 electric generators, 23 of the latter belonging to the Union Carbide Company, and 9 to the Michigan Lake Superior Power Company. The capacity of each generator belonging to the Union Carbide Company is 375 K.W., and of each of the generators belonging to the Power Company 400 K.W.

The delivery of water into the power canal is controlled by head-gates, located about 2,400 feet east of the intake entrance, at the beginning of the rock section of the canal. They consist of four Stonie steel sluice gates, operated between masonry piers by hand winches and suitable trains of gear. The piers, gate sills and abutments are all founded on rock. The gates are counter-balanced for ease in operating. The piers between the gates are spanned by steel and concrete arches, making a bridge with ample strength for either railroad or street purposes.

The mean difference in height between the upper and lower levels of St. Marys river is about 19.3 feet. It is estimated that when the canal is operating to its full capacity the loss in frictional and other resistances to the flow of the water will be about 3 feet, making the mean effective head at the power-house about 16 feet or a little over.

The total cost of the Michigan Lake Superior Power Company's plant to date is \$6,500,000.

6. THE WEST NEEBISH CHANNEL.

On Wednesday, the 15th, the sub-committee embarked again on board the steamship *Alfred Noble*, kindly placed at their disposal by the Office of the Corps of En-

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engineers of the United States army at the Soo, to visit the new double track channel which is now being constructed. This will be another road through Hay lake and the West Neebish which will be completed in 1908.

Contract has been let for the construction of a channel 300 feet wide and 22 feet deep, for a distance of 13,300 feet through the rapids, with a stone retaining wall along each side of the rock cut. About 6,000 lineal feet of the cut was to be inclosed by cofferdams and the included portion of the channel is excavated in the dry. These intermediate dams shut off all flow of water through the West Neebish. The upper and lower main dams were partially constructed by a dredge casting over excavated material consisting of gravel, sand or clay, and finished by depositing stones and gravel until the height of the dam was about 6 feet above the water surface. The construction of these two cofferdams was commenced in August, 1904, and finished in August, 1905.

The contractors, at the close of the year 1904, had also made good progress in other preliminary works in connection with the construction of this 300-foot channel through the West Neebish rapids, including roadways, framing of cable towers for the Telferage system, boarding houses, store, dock and assembling of plant.

By the construction of the two temporary cofferdams, the water was raised three-quarter inches in pool above the upper dam. The contractors are employing, for the excavation of this solid rock bed, two air compressors of 750 and 250 horse-power respectively, and of 75 pounds pressure. The sides are first being channeled, and a vertical retaining wall is being built along each side of the channel to a height of six feet above low water. Drilling is done with 16 drills, and 50 per cent dynamite is used for blasting. The material is removed by four cableways, two of them 800 feet between the towers, and two of them 1,100 feet between the towers. The towers are 90 feet high. The skips used are steel, with dimensions of 8 x 8 x 2½ feet. There is a steel shovel of 76 tons weight, which is used in loading skips, and two more shovels of 120 tons each are to be added next spring. The average working force is 150 labourers and 49 skilled mechanics and foremen. There were 1,586,000 cubic yards of rock to be excavated above 22 feet grade at the rate of \$1.36 per cubic yard, and 95,000 cubic yards between 22 and 23 feet grades are to be excavated at 68 cents per cubic yard. As above stated, this gigantic work was begun in May, 1904, and will probably be completed before the opening of navigation in the spring of 1908. That would make what we may call a double track channel of 300 feet from Sault Ste. Marie to Detour Point.

The mean level of Lake Superior for the years 1860 to 1904, both inclusive, is 602.29 feet above mean tide at New York. The discharge of the St. Marys river for this elevation of the lake, as measured in 1902, is 75,000 cubic feet per second. The increase in discharge per foot rise of lake is approximately 15,500 cubic feet per second.

The United States engineer of the War Department in charge at Sault Ste. Marie informed the sub-committee that they are now preparing a plan for a 25 foot channel, thus deepening the middle and west channels an additional four feet, without further widening. The material which has been excavated from the St. Marys river is silt, sand, clay, gravel, stones, boulders, hard pan, sandstones and limestone bed rock. The dredging operations are all conducted under contracts. The inspectors of dredging are paid by the United States government at the rate of \$85 per month and their board while employed during the working season. The total amount spent up to the present time by the United States government in improving St. Marys river is as follows: Canal, \$8,000,000; river channel, \$4,000,000; making a total of \$12,000,000.

Returning to the Soo in the afternoon, the committee visited the plants and works of the Chandler-Dunbar Water Power Company and those of the Edison Sault Electric Company.

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7. THE CHANDLER-DUNBAR WATER POWER COMPANY, AND THE EDISON SAULT
ELECTRIC COMPANY.

The Chandler-Dunbar Water Power Company was incorporated in virtue of the same Act which gave legal existence to the Michigan Lake Superior Power Company, viz.: Act No. 39 of the Public Acts of the State of Michigan, to authorize the formation of a corporation for the purpose of excavating, constructing, and maintaining water courses with water-power appurtenant thereto, for accumulating, storing, conducting, selling, furnishing and supplying, upon an agreed rental, water and water-power for mining, milling, manufacturing, domestic, municipal, and agricultural purposes.

The Chandler-Dunbar Water Power Company claim to have been for many years past, the owners of the south bank and shore of the St. Marys river at the rapids, in the city of Sault Ste. Marie, in the County of Chippewa, in the State of Michigan, from a point 700 feet above and west of, to a point of 2,300 feet below and east of the south end of the International Bridge, across St. Marys river, and also of the bed of the St. Marys over and against said rapids extending from the south bank and shore of said river northerly to the international boundary line between the United States on one side and the Dominion of Canada on the other side; and extending from above the head of the falls in the St. Marys river nearly to the foot of the said falls.

The volume of the flow in St. Marys river at the ordinary low water stage, at and past the land of the Chandler-Dunbar Water Power Company, over and above the amount required for navigation, is, according to the Engineer of the company, about 3,600,000 cubic feet per minute, or 60,000 feet per second. At higher stages the flow is naturally much more. There is, upon the lands of the company, a fall of the water to the extent of about 12 feet, according to an estimate of the Engineer of the company.

The Chandler-Dunbar Water-Power Company claim that at least half of this flow of water is appurtenant to the American shore and appurtenant to the lands of the company. It is, therefore, the intention of the company and its lessee, the Edison Sault Electric Company, to take and use, where it passes the lands of the company, for the production of available power all of such flow appurtenant to the said lands, excepting only such amount as may be required for navigation. The character of the proposed works is in each case a dam containing penstocks and wheels; the dam is designed to raise the level of water in the rapids, above the dam, to the level of Lake Superior, or as near as may be. The penstocks and wheels to have sufficient capacity to discharge and utilize all the flow of the rapids of the St. Marys river south of the international boundary. The penstocks will be provided with waste weirs for use when the wheels are to be stopped. The tailraces will be excavated to as low a level as circumstances will permit in order that the entire available head may be utilized.

The Chandler-Dunbar Water-Power Company are building their present works in virtue of certain permits which have been granted them by the United States War Office, and they also claim the ownership of what is generally called Island No. 1 and Island No. 2, in virtue of letters patent, granted them on December 15, 1883. Said letters patent read as follows:—

‘ UNITED STATES OF AMERICA.

‘ To all to whom these presents shall come, Greeting:

‘ Special Act of Congress }
‘ April 11, 1860. }

‘ Whereas, in pursuance of the Special Act of Congress, approved April 11, 1860, entitled, “An Act for the relief of the legal representatives of Charles Porterfield, deceased,” there has been deposited in the General Land Office, warrant No. 123, for 40 acres in favour of William Kinney and Thomas J. Michie, as executors of Robert Porterfield, deceased, or their assignees, should any assignment from them as such executors, under the provisions of the will of Robert Porterfield as directed by the Act

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in question, be duly indorsed thereon, and, whereas there is indorsed on said warrant an assignment duly executed in favour of William Chandler, with evidence that the same has been duly located upon all that certain lot or parcel of land, being a portion of section numbered six in township numbered forty-seven, north of range numbered one, east of Michigan meridian in the State of Michigan, designated upon the official plan of the survey of the village of Sault Ste Marie, made by United States Deputy Surveyor Thomas Whelpley, in 1854 and 1855, under and by virtue of an Act of Congress, approved September 26, 1850, entitled, "An Act providing for the examination and settlement of claims for land at the Sault Ste. Marie, in Michigan," which survey was approved by Leander Chapman, United States Surveyor General for the state of Michigan, September 4, 1855, and is now on file in the office of the Commissioner of the General Land Office at Washington, D.C., as "part of the Indian reservation," said tracts being bounded by the River St. Marys on the east, north and west, and by the St. Marys Falls canal and portage street extended on the south, the same being more particularly described by courses and distance as follows: Beginning at the intersection of the principal meridian of Michigan with River St. Mary, being 90 links north of St. Mary's canal, and being the northwest corner of northeast part of claim No. 3; thence north 71 degrees, 39 feet east 4:00 chains; thence north 4 degrees, 37 feet west 3:65 chains to the northwest corner of said tract. being the initial point of the survey of said tract; thence south 4 degrees, 37 feet east 1:00 chains; thence south 77 degrees, 10 feet west 15:00 chains; thence north 85 degrees, 23 feet east 18:89 chains; thence north 18 degrees, 39 feet west 2:06 chains; thence north 80 degrees, 40 feet west 1:66 chains; thence south 88 degrees, 15 feet west 4:01 chains; thence north 84 degrees, 41 feet west 4:06 chains; thence south 85 degrees, 23 feet west 3:00 chains; thence north 89 degrees, 54 feet west 4:01 chains; thence south 79 degrees, 57 feet west 4:02 chains; thence north 69 degrees, 19 feet west 4:42 chains; thence south 87 degrees, 56 feet west 8:9 chains, to the initial point of survey; being the northwest corner of the said tract containing $9 \cdot 10\frac{3}{4}$ acres of land, more or less, in the district of land subject to sale at Marquette, Michigan, according to the official plat of the survey of the said land returned to the General Land Office by the Surveyor General. Now know ye, that there is, therefore, granted by the United States unto the said William Chandler the tract of the land above described, to have and to hold the said tract of land with the appurtenance thereof, unto the said William Chandler and his heirs and assigns forever.

'In testimony whereof, I Chester A. Arthur, President of the United States of America, have caused these letters to be made patent, and the seal of the General Land Office to be hereunto affixed.

'Given under my hand at the city of Washington, the fifteenth day of December, in the year of our Lord, one thousand eight hundred and eighty-three, and of the independence of the United States the one hundred and eighth.

'(Seal)

'United States General Land Office.

'By the President,

CHESTER A. ARTHUR.

'By

WM. H. CROOK, *Secretary*.

'S. W. CLARK, Recorder of the General Land Office.

'Recorded, Vol. 6, Pages 1, 2 and 3.'

8. THE REVOCABLE LICENSES GRANTED BY THE UNITED STATES WAR DEPARTMENT TO THE
CHANDLER-DUNBAR WATER-POWER COMPANY OR TO ITS LESSEE, THE
EDISON SAULT ELECTRIC COMPANY.

They are seven in number and read as follows by order of dates:

Revocable License, No 1 (March 14, 1889).

The Edison Sault Light and Power Company, of Sault Ste. Marie, a corporation existing under the laws of the state of Michigan, is hereby granted a license, revocable

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at will by the Secretary of War, to erect and maintain a dam on the rapids of the St. Marys river, between the mainland and Island No. 3, and within the limits of the lines marked 'Proposed Embankment Dam,' on the map hereto attached and made a part of this instrument, upon the following provisions and conditions:

1. That said dam shall be so constructed as not to interfere with private rights or public interests and improvements.

2. That the engineer officers of the United States Army, in charge of the district within which the dam is to be constructed may supervise its construction as far as may be necessary, to secure the compliance with the conditions herein obtained.

3. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is this date, shall be repaid by said Edison Sault Light and Power Company on demand.

Witness my hand this fourteenth day of March, 1889.

(Signed) REDFIELD PROCTER,
Secretary of War.

This license, with the terms, provisions and conditions set out therein, is hereby accepted this fifth day of March, 1889.

THE EDISON SAULT LIGHT AND POWER COMPANY,

MR. C. E. AINSWORTH, *President.*

E. S. B. SUTTON, *Secretary.*

Signed in presence of J. H. Goff, W. Chandler, Chas. G. Clarke, Thomas J. Martin and Frank Perry, all of Sault Ste. Marie, Michigan.

Revocable License, No. 2 (August 8, 1892).

The Edison Sault Electric Company is hereby granted a license, revocable at will by the Secretary of War, to construct and to maintain an embankment dam in the St. Marys rapids, adjacent to its property at Sault Ste. Marie, Michigan, and extending into the river to a point half the distance from the shore to Islands Nos. 1 and 2, in accordance with the general plan shown on the map hereto attached, upon the following provisions and conditions:

1. That no portion of the dam, except that extending to Island No. 3, shall be so constructed as to extend further than midway between the company's property and islands Nos. 1 and 2.

2. That the engineers officers of the United States Army, in charge of the district within which the dam is to be built, may supervise its construction as far as may be necessary to secure compliance with the conditions of this license.

3. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is at this date, shall be repaid by said Edison Sault Electric Company on demand.

Witness my hand this nineteenth day of August, 1892.

(Signed) L. A. GRANT,
Acting Secretary of War.

This license, with the terms, provisions and conditions set out therein, is hereby accepted this eighth day of August, 1892.

(Signed) EDISON SAULT ELECTRIC COMPANY,

BY HARRIS T. DUNBAR, *President.*

Signed in presence of F. E. Dunbar.

Engineer's Department, 1892, No. 3390.

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Revocable License, No. 3 (July 8, 1893).

The Edison Sault Electric Company is hereby granted a license, revocable at will by the Secretary of War, to enter upon the land of the United States, forming part of the St. Marys Falls Canal grounds, at Sault Ste. Marie, Michigan, and to widen the tail-race now in use by the said company, between its power house and Island No. 3, from 15 to 25 feet, and to extend the small embankment dam running down from the Island No. 3 to Island No. 4, all as shown on the attached plat of a part of the canal grounds, the red lines on the plat showing the extent of the proposed work, upon the following provisions and conditions:—

1. That unless sooner revoked, this license shall expire at the end of five years from the date of its execution.

2. That the excavated material shall not be removed, but it shall be deposited back (south) of its present position.

3. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is at this date, shall be repaid by the said Edison Sault Electric Company on demand.

Witness my hand this sixth day of July, 1893.

(Signed) L. A. GRANT,
Acting Secretary of War.

Office, Chief of Engineers, United States of America, Inclosure 2 of 3081.

Received, Office Chief of Engineers, July 8, 1893.

Revocable License, No. 4 (April 4, 1902).

Whereas, by revocable license, dated August 13, 1892, the Acting Secretary of War gave unto the Edison Sault Electric Company permission to construct and maintain an embankment dam in the St. Marys River rapids, adjacent to its property at Sault Ste. Marie, Michigan, and extending into the river to a point half the distance from the shore to Islands Nos. 1 and 2, in accordance with the general plan shown on the map thereto attached, and subject to the conditions therein contained;

And whereas, said Edison Sault Electric Company has now applied to the Secretary of War for a modification of said license of August 13, 1892, so as to permit the construction of the proposed new power station indicated at A-A1 on the attached blue-print, and to extend the present embankment, as indicated by the heavy white line from *a* to *c*, and to remove the red lined section *a, b*; also to make a new tail-race outside of Island No. 3, at said place, all as shown on the attached blue print;

Now, therefore, this is to certify that the Secretary of War hereby modifies said revocable licenses of August 13, 1892, so as to permit the construction of a proposed new power station, indicated at A-A1 on the attached blue print, and to extend the present embankment, as indicated by the heavy white line from *a* to *b*, and to remove the red line section *a, b*, shown on said blue print; also gives unto said company permission to make a new tail-race outside of Island No. 3, at said place, as shown on said blue print, subject to the following conditions:—

1. That this permission shall not be construed as authorizing any invasion or impairment of the riparian rights of any other person or corporation, and the right to withdraw the permission for use of this tail race whenever the interests of the government so requires, is expressly reserved.

2. That the work of cleaning and deepening the tail race shall conform to the plan outlined in the company's letter of March 23, 1901, a copy of which is hereto attached.

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3. That as soon as the new tail-race is ready for use said company shall abandon the tail-race now used on the inside of Island No. 3, and relinquish to the United States all rights of the company between said island and the shore.

4. That the work herein permitted to be done shall be subject to the supervision and approval of the Engineer Officer of the United States Army in charge of the locality.

5. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is at this date, shall be repaid by said Edison Sault Electric Company on demand.

Witness my hand this fourth day of April, 1901.

(Signed) ELIHU ROOT,
Secretary of War.

Office, Chief of Engineers, War Department, April 6, 1901, No. 38452.

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The following letter is annexed to the preceding license, and forms part of the official records of the War Department in Washington:—

THE SHOREHAM,
WASHINGTON, D.C., March 23, 1901.

Honourable SECRETARY OF WAR, Washington, D.C.

SIR,—In addition to the plan of the proposed tail-race, for which we are making application to improve, and to which this is attached and made a part.

We would state that it is our desire to clear out the driftwood, loose boulders, rock and such other material as may be encountered, to a depth of not exceeding 10 feet below the present surface; this at a point where the property of our company on the east intersects with that of the government, and on the lines indicated by the plan herein referred to.

From this as a grade starting point, we wish to extend the improvement downstream on the lines indicated by our plan, gradually decreasing the depth of excavation as the slope of the bottom requires, until a plane is reached when no further excavation would be required, the natural surface and improved channel being on the same grade, at a point not lower down the channel than the westerly extremity of Island No. 5.

It is not intended or requested on our part to make any permanent embankments on either side of the excavation so applied for unless required by the government.

It is not expected on our part that after completing the improvements herein contemplated that we will change the volume of flow of water on the government property, which we now seek to utilize. It is hoped on our part to pass the same amount of water over the same areas as would naturally flow, concentrating its fall at a given point and utilizing it for commercial purposes, instead of as at present the fall is diffused over a long distance and goes to waste.

Very respectfully,

EDISON SAULT ELECTRIC.

Revocable License, No. 5 (June 9, 1902).

The Chandler-Dunbar Water-Power Company, Sault Ste. Marie, Michigan, is hereby granted a license, revocable at will by the Secretary of War, to occupy, for the purposes of the extension of said company's dock, a small area of land belonging to the United States government at Sault Ste. Marie, Michigan, as shown by red lines on the attached drawing, upon the following provisions and conditions:

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1. That the United States shall have a perpetual right to the free use of said dock in the future, so far as needed for government work connected with future canal operations and improvements, as Sault Ste. Marie, Michigan.

2. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is at this date, shall be repaid by said Chandler-Dunbar Water-Power Company on demand.

Witness my hand this ninth day of June, 1902.

(Signed) WM. CARY SANGER,
Assistant Secretary of War.

Office, Chief of Engineers, War Department, June 10, 1902, No. 42721.

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Revocable License, No. 6 (March 10, 1904).

Whereas, by revocable license, dated August 13, 1892, the Acting Secretary of War gave unto The Edison Sault Electric Company permission to construct and maintain an embankment dam, in the St. Marys river rapids, adjacent to its property at Sault Ste. Marie, Michigan, and extending into the river to a point half the distance from the shore to Islands Nos. 1 and 2, in accordance with the general plan shown on map hereto attached, and subject to the conditions therein contained;

And whereas, by an instrument dated April 4, 1901, the Secretary of War modified said revocable license of August 13, 1892, so as to permit the construction of a proposed new power station, indicated at A-A¹ on the blue print hereto attached, and to extend the embankment, as indicated by the heavy white line from *a* to *c*, and to remove the red line section *a b*, as shown on said blue print; and also gave unto said company permission to make a new tail race outside of Island No. 3, at said place, as shown on said blue print, subject to the conditions therein contained;

And whereas, said Edison Sault Electric Company has now applied to the Secretary of War for a modification of said permit of April 4, 1901, as hereinafter specified, so as to allow it to build further out into the rapids of the St. Marys river, in front of the shore properties owned or leased by said company;

Now, therefore, this is to certify that, in accordance with the recommendation of the Chief of Engineers, the Secretary of War hereby modifies said instrument of April 4, 1901, so as to permit said company to build further out into the rapids of the St. Marys river, at said place; the work herein authorized being shown on the attached blue print, and specifically described by reference thereto, as follows:

1. The removal of the wall and buildings (*abB*), coloured red.
2. The substitution of a somewhat larger power-house (*EE*) and a longer wall (*a d*), coloured yellow, in place of the already authorized power-house (*AA¹*) and wall (*ac¹*), coloured white.
3. The construction of a wider tail-race (*G. G¹*) below the power-house, of width suited to the latter, in lieu of the old tail-race (*f f¹*).

These modifications are made on the following conditions:

1. That this permission shall not be construed as authorizing any invasion or impairment of the riparian rights of any other person or corporation, and the right to withdraw the permission for use of this tail-race whenever the interests of the government so require, is expressly reserved.

2. That the work of clearing and deepening the tail-race shall conform to the plan outlined in said company's letter of March 23, 1901, a copy of which is hereto attached.

3. That as soon as the new tail-race is ready for use, said company shall abandon the tail-race now used on the inside of Island No. 3, and relinquish to the United States all rights of the company between said islands and the shore.

4. That the work herein permitted to be done shall be subject to the supervision and approval of the engineer officer of the United States Army in charge of the locality.

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5. That any sum which may have to be expended, after revocation of this license, in putting any premises or property, hereby authorized to be occupied or used, in as good condition for use by the United States as it is at this date, shall be repaid by said Edison Sault Electric Company on demand!

6. That the area now occupied by the old building and old tail-race shall be abandoned to the United States, as soon as the new buildings and new tail-race can reasonably be completed and ready for service.

Witness my hand this tenth day of March, 1904.

(Signed) WM. CARY SANGER,
Acting Secretary of War.

Office, Chief of Engineers, War Department, March 13, 1904, No. 38452.

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The following letter is annexed to the present patent, and forms part of the official records of the War Department in Washington:—

THE SHOREHAM,
WASHINGTON, D.C., March 23, 1901.

Honourable SECRETARY OF WAR, Washington, D.C.

SIR,—In addition to the plan of the proposed tail-race, for which we are making application to improve, and to which this is attached and made a part,

We would state that it is our desire to clear out the driftwood, loose boulders, rock and such other material as may be encountered, to a depth of not exceeding 10 feet below the present surface; this at a point where the property of our company on the east intersects with that of the government, and on the lines indicated by the plan herein referred to.

From this as a grade starting point, we wish to extend the improvement downstream on the lines indicated by our plan, gradually decreasing the depth of excavation as the slope of the bottom requires, until a plane is reached where no further excavation would require, the natural surface and improved channel being on the same grade not lower down the channel than the westerly extremity of Island No. 5.

It is not intended or requested on our part to make any permanent embankment on either side of the excavation so applied for unless required by the government.

It is not expected on our part, after contemplating the improvements herein contemplated, that we will change the volume or flow of water over the government property which we now seek to utilize. It is hoped on our part to pass the same amount of water over the same area as would naturally flow, concentrating its fall at a given point and utilizing it for commercial purposes, instead of as at present the fall is diffused over a long distance and goes to waste.

Very respectfully,
EDISON SAULT ELECTRIC COMPANY.

WAR DEPARTMENT,
WASHINGTON, July 30, 1903.

GENTLEMEN,—Referring to previous correspondence concerning the suspension of the permission heretofore granted the Edison Sault Electric Company, to build its embankment dam, power house and other works farther out into the St. Marys river rapids at Sault Ste. Marie, Michigan, I beg to inform you that I have this day executed an instrument modifying the permit of March 10, 1903, granting the permission above referred to, so as to have thereto the following conditions:—

‘That no part of the proposed embankment dam, power house and other works shall be so constructed as to extend farther into the river than one-half of the distance from shore to the nearer island of the Islands Nos. 1 and 2.

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'That the present rock bottom in the river at the head of the rapids and head of the head race shall not be cut away or otherwise lowered or deepened.'

Very respectfully,

(Signed) ELIHU ROOT,

Secretary of War.

Messrs. Shaw, Warren, Cady & Oakes,

Attorneys for St. Marys Power Company, Detroit, Mich.

OFFICE OF CHIEF OF ENGINEERS,

December 23, 1903.

NOTE:—

Paragraph 7 of the notice of July 30, 1903, modified as follows: (See 17th ind. on 46393, and ind. of Acting Secretary of War, October 31, 1903, on 46393), viz.:—

'That no part of the proposed embankment dam, power house and other works shall be constructed above a line extending from the foot of Island No. 2, at right angles to the general course of the channel between said island and the shore, so as to extend farther into the river than one half of the distance from the shore to the nearer island of Islands Nos. 1 and 2; and that around the foot of Island No. 2, such construction shall leave at all stages of water a free water flow, at least equal in total cross section and volume to that now passing between Islands Nos. 1 and 2, and the nearest parts of the embankment of the August 13, 1892, permit.'

Revocable License, No. 7 (May 8, 1905).

Whereas, by instrument dated March 10, 1903, as subsequently modified by instrument dated July 30, 1903, permission was granted by the Secretary of War to the Edison Sault Electric Company, to construct an embankment dam, power house and accessory works in the St. Marys river at Sault Ste. Marie, Michigan, as specifically described in said instrument of March 10, 1903, and shown on the map attached thereto; such permission, however, being subject to the conditions set forth in said instrument of March 10, 1903, as modified by said instrument of July 30, 1903;

And whereas, application is now made by said Edison Sault Electric Company for permission to make certain alterations in the proposed work and certain additional constructions in connection therewith; and the Chief of Engineers, United States Army, has recommended that permission be given to the extent hereinafter set forth;

Now, therefore, this is to certify that the Secretary of War hereby gives the said Edison Sault Electric Company permission for the construction of a temporary sand-bag cofferdam, as indicated in red on the attached blue print, and described by reference thereto as extending from the point G to Island No. 1, between Islands Nos. 1 and 2, and from Island No. 2 to the point F.

This permission, however, is given upon the following conditions:—

1. That the said temporary sand-bag cofferdam shall be entirely removed by said company not later than the close of navigation of the calendar year, 1905.

2. That the work herein permitted and required to be done shall be subject to the supervision and approval of the engineer officer of the United States Army in charge of the locality.

Witness my hand this eighth day of May, 1905.

(Signed) WM. H. TAFT,

Secretary of War.

Office of Chief Engineer, War Department, May 15, 1905, No. 38452.

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The United States government has entered a suit in the Circuit Court of the United States for the Western District of Michigan, Northern Division, against the Chandler-Dunbar Water Power Company, claiming the ownership of Island No. 1 and Island No. 2, and asking that the letters patent granted them in 1883 be cancelled and declared void. The suit was commenced by the United States, under the direction of the Attorney-General, on September 2, 1903. All testimony and records and documentary evidence have been taken, and the case was heard last spring, and judgment was given on July 20 last, by Mr. Justice P. Wanty, dismissing the action of the United States government and maintaining the Chandler-Dunbar Water Power Company in their act of ownership to Islands Nos. 1 and 2.

The United States, as complainant, claims that it is the owner of Islands Nos. 1 and 2, situated in the rapids of the Straits of St. Mary, north of the ship canal and locks belonging to it; that said islands are situated in public waters, to which no riparian rights can be attached, and that the continued undisturbed ownership and possession thereof is essential to the present and future operation and enlargement of said works in aid of commerce, and also essential to enable the United States to fulfil its international obligations to Great Britain, by maintaining the communicating waterways of the Great Lakes as public waters.

The defendant denies the public character of the waters in which said islands are situated, and asserts that the ownership of said islands attaches to the ownership of the adjacent shore title on the American side. The defendant also denies that said islands are needed by the United States for public purposes, and denies that their ownership and possession are essential to the performance of the international obligations of complainant.

The defendant claims to be the owner of said islands by virtue of a patent issued on December 15, 1883, to its grantor, William Chandler, asserting that said title attaches also to said islands by virtue of its alleged riparian ownership.

The complainant claims that said islands, together with a quantity of land on the south shore of the straits, on a part of which a ship canal and locks are constructed and in operation, have been reserved since the year 1882, and at any rate since April 3 and September 2, 1847, for public purposes.

The defendant, while admitting such reservation in 1847, claims that said reservation has been released:

(a) By order of the President on December 9, 1852;

(b) By the abandonment of an Indian right of occupancy by a treaty, proclaimed April 24, 1856;

(c) By the Act of September 26, 1850, and the operations thereunder, such operations including the survey of the mainland at Sault Ste. Marie, by Thomas Whepley, in 1854 and 1855.

The complainant alleges that the tract patented to Chandler was not included in the Whepley survey and was never included in any other survey of the public lands, and that, therefore, the land was not subject to be taken by location with Porterfield Scrip, which is the basis of the Chandler title, under the very terms of the Act of Congress authorizing the use of such scrip.

The defendant alleges that this suit is not brought in good faith by the United States, but that its object, instead of being the assertion of the rights and duties set out in complainant's bill, is to assist a private corporation, the Michigan Lake Superior Power Company, to divert water from flowing past the land covered by defendant's alleged title.

The complainant insists that this suit is brought in good faith, for the objects and purposes set out in its bill.

The defendant also relies upon the Statute of Limitations of March 3, 1891, which provides that suit by the United States to vacate and annul any patent theretofore issued, shall only be brought within five years from said date.

The complainant insists that the patent issued to Chandler in 1883 was not voidable, but absolutely void, because the land embraced therein, being in a state of reserva-

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tion, was not subject to disposal under the public land laws of the United States, and that a void title is not within the intent of said Statute of Limitations; and complainant insists, further, that said Statute of Limitations does not apply, because said title is also void for the reason that the land covered by said patent has never been surveyed into legal subdivisions, or at all, and was not, therefore, subject to a location by Porterfield scrip.

The defendant also alleges that the complainant is estopped by its dealings with the defendant and by its laches to deny the title of defendant to the upland alleged to be embraced in the patent to defendant's grantor.

As above stated, Judge Wanty maintained the plea of the Chandler-Dunbar Water-Power Company in the Circuit Court of the United States for the western district of Michigan, northern division. The Attorney General has appealed from that judgment to a higher court, and the question has not yet been argued.

9. THE CONSOLIDATED LAKE SUPERIOR POWER COMPANY.

On Thursday the committee again embarked on board the United States government steamer *Alfred Noble*, and went to the Canadian side to visit the plants of the Consolidated Lake Superior Power Company. This company was incorporated under the Revised Statutes of Ontario, chapter 164, as the Sault Ste. Marie Water, Gas and Light Company, on June 30, 1888. By chapter 88, of the Ontario statutes, 1889, the company's name was changed to 'The Ontario Water, Light and Power Company.' By section 4 of this Act, the company obtained the power to build dams across the island channels or rapids of the St. Marys river or of any branch within the province of Ontario, and also to conduct water from the said river and the various branches thereof for hydraulic purposes; also to make flumes, canals or other works to secure the necessary supply of water for their works. The provisions of the section were to be exercised only with the consent of the Crown or the individuals affected. The company was also authorized to sell, lease or otherwise dispose of surplus water from their dams, flumes or canals. By the Ontario Act of 1890, chapter 135, the corporation of Sault Ste. Marie was authorized to take stock in the Ontario and Sault Ste. Marie Water, Light and Power Company, and an agreement with this view was ratified and is annexed to chapter 135, above described.

By the Ontario Act of 1895, the name of the company was changed into 'The Lake Superior Power Company,' all rights, powers and privileges to be enjoyed as theretofore granted. The St. Marys island, containing an area of 170 acres, was part of the military lands, expressly vested in the Crown for the purposes of the province of Canada by the Act 19 Vic., chapter 45, section 6 (1856). The northerly portion, comprising 10·10 acres of St. Marys island, which belonged to the Dominion as ordnance lands, was granted by way of exchange of properties to the Lake Superior Power Company by Dominion letters patent, dated March 19, 1896. They covered the said parcel of land and land covered with water, being a portion of St. Marys island and the adjacent waters, and reserved the free use of all navigable waters that might thereafter be found on, under, or flowing through, or upon any part of the land. These letters patent read as follows:—

'Special grant by Her Majesty the Queen to the Lake Superior Power Company, of parcel or tract of land and land covered by water, being a portion of the St. Marys island and the adjacent waters, being in the town of Sault Ste. Marie, in the district of Algoma, Ontario, dated March 18, 1896, recorded March 19, 1896.

'J. POPE,

'Acting Deputy Registrar General of Canada.

'JOHN J. McGEE,

'Deputy Governor.

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CANADA:

‘Victoria, by the Grace of God, of the
 ‘United Kingdom of Great Britain and
 ‘Ireland, Queen, Defender of the Faith.
 ‘etc., etc., etc.

‘To all these presents shall come, Greeting:

‘Whereas the lands hereinafter described have been required for a public work of Canada, and the same are no longer required for such public work;

‘And whereas, pursuant to the Statutes and under the authority of our Governor in Council in that behalf, we have agreed to grant the said lands to the Lake Superior Power Company, hereinafter called “the said company,” in exchange for certain other lands, situated at the town of Sault Ste. Marie, in the province of Ontario, and the said last mentioned lands have been duly conveyed to us by ‘the said company.”

Now know ye, that in consideration of the premises, we do grant, convey and assure unto “the said company” all and singular that certain parcel or tract of land and land covered by water, being a portion of St. Marys Island and the adjacent waters, situated, lying and being in the town of Sault Ste. Marie, in the District of Algoma, and province of Ontario, and which may be more particularly known and described as that portion of St. Marys Island and adjacent waters, the property of the government of the Dominion of Canada, lying to the north of a straight line to be hereinafter described, and bounded on the west by the southerly production of the easterly limit of West street, and on the east by the Laird & Henderson mill site (a tract of 12 acres, granted by Letters Patent, dated June 7, 1877, to John Laird and Jonathan Henderson); the above mentioned straight line is drawn from a point on the southerly production of the easterly limit of West street, distant one thousand one hundred and forty-nine and four-tenths (1,149 4-10) feet, measured southerly along said production from the southerly limit of Portage street to a point on the southerly production of the westerly limit of Andrew street, distant nine hundred and thirty-six and four-tenths (936.4-10) feet, measured southerly along said production from the said southerly limit of Portage street; the above described parcel contains by admeasurement ten and ten hundredths (10.10) acres, be the same more or less, and is shown coloured pink on a plan hereto annexed, saving, excepting and reserving unto us, our successors, and assigns the free uses, passage and enjoyment of, in, over and upon all navigable waters that shall or may be hereafter found on, or under, or be flowing through, or upon any part of the said parcel or tract of land hereby granted as aforesaid.

‘To have and to hold the said parcel or tract of land unto “the said company,” its successors and assigns forever.

‘Given under the Great Seal of Canada:

‘Witness: John Joseph McGee, Esquire, Deputy of Our Right Trusty and Right Well-Beloved Cousin and Councillor the Right Honourable Sir John Campbell Hamilton Gordon, Earl of Aberdeen, Viscount Formartine, Baron Haddo, Methlic, Traves and Kellie, in the Peerage of Scotland; Viscount Gordon of Aberdeen, County of Aberdeen, in the Peerage of the United Kingdom, Baronet of Nova Scotia, Knight Grand Cross of our Most Distinguished Order of Saint Michael and Saint George, etc., etc., Governor General of Canada.

‘(E. L. Newcombe, Deputy of the Minister of Justice, Canada.)

‘At our Government House, in our City of Ottawa, this eighteenth day of March, in the year of Our Lord, one thousand eight hundred and ninety-six, and in the fifty-ninth year of our reign.

‘JOHN HAGGART,

‘*Minister of Railways and Canals.*

‘By COMMAND:

‘JOSEPH POPE,

‘Acting Under Secretary of State.’

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The Lake Superior Power Company are at present the owners of the Laird & Henderson mill site, which comprised a certain area of water and islands therein north of St. Marys island. This mill site had been granted by Letters Patent from the province of Ontario on June 7, 1877, to John Laird and Jonathan Henderson. Said Letters Patent read as follows:—

‘D. A. MACDONALD,
‘PROVINCE OF ONTARIO,’

‘Victoria, by the Grace of God of the
‘United Kingdom of Great Britain and
‘Ireland, Queen, Defender of the Faith.

‘To all to which these presents shall come, Greeting:

‘Whereas, John Laird, of the town of Sault Ste. Marie in the District of Algoma, miller, and Jonathan Henderson, of the same place, merchant, have contracted and agreed for the absolute purchase of the lands and tenements hereinafter mentioned and described at and for the price of or the sum of twelve dollars of lawful money of Canada, and of which lands we are seized in right of our Crown.

‘Now know ye, that in consideration of the said sum of twelve dollars, well and truly paid to our use, at or before the sealing of these, our Letters Patent, we have granted, sold, aliened, converted and assured, and by these presents do grant, sell, alien, convey and assure unto the said John Laird and Jonathan Henderson, their heirs and assigns forever.

‘All that parcel or tract of land and land covered with water, situate, lying and being at the town of Sault Ste. Marie in the District of Algoma, in the province of Ontario, containing by admeasurement twelve acres, be there more or less, which said parcel or tract of land may be otherwise known as follows, that is to say: Being composed of a mill site at the town of Sault Ste. Marie, in front of the township of Awenge, as shown by the green colour on a plan by provincial land surveyor, Isaac Traynor, dated May 5, 1877, of record in the Department of Crown Lands, a copy of part of which plan is attached to these Letters Patent, together with the right of way one chain wide from the said mill site to the Korah road, as shown on the said plan by the red colour.

‘To have and to hold the said parcel or tract of land hereby granted, conveyed, assured unto the said John Laird and Jonathan Henderson, their heirs and assigns for ever, saving, excepting, and reserving, nevertheless, unto us, our heirs and successors, the free uses, passage and enjoyment of, in, over and upon all navigable waters that shall or may be hereafter found on, or under, or be flowing through, or upon any part of the said parcel or tract of land hereby granted as aforesaid.

‘Given under the Great Seal of our province of Ontario.

‘Witness, the Honourable Donald Alexander MacDonald, Lieutenant Governor of our province of Ontario;

‘At Toronto, this seventh day of June in the year of Our Lord, one thousand eight hundred and seventy-seven, and in the fortieth year of our reign.

‘By command of the Lieutenant-Governor in council.

‘ARTHUR S. HARDY, C.L.S.,

‘Secretary.

‘THOMAS H. JOHNSTON,

‘Assistant Commissioner of Crown Lands.

‘Ref. 41,125; Toronto, 37,551; F.D.W.F.’

The Lake Superior Power Company also acquired from H. C. Hamilton and his wife a piece of land adjacent to the Laird and Henderson mill site, by a deed, executed

on June 30, 1890, and duly registered at the registry office of the district of Algoma, in the town of Sault Ste. Marie, Ontario.

The present industrial activity and development at the Soo may be said to date from October, 1894, when an agreement was entered into between Francis H. Clergue, of New York city, and Edward V. Douglas, of Philadelphia, for the purchase of the Ontario and Sault Ste. Marie Water, Light and Power Company. This company was originally formed for the development of power from the falls of the St. Marys river on the Canadian side, but after doing a certain amount of work, including the partial construction of a power canal, found itself financially embarrassed and unable to properly proceed with the completion of the work so that a revenue could be derived from it. The town of Sault Ste. Marie was practically the owner of the company, only a part of the capital stock being held by individuals. The company, in addition to their power privileges, were also the owners of franchises from the town of Sault Ste. Marie, for electric lighting, water and street railway privileges. The transactions of Messrs. Clergue and Douglas are a matter of public record, and can be found in chapter 119 of the statutes of Ontario for the year 1895. Under this Act, which was assented to April 16, 1895, Mr. Clergue and his associates took over the complete property and franchises of the Ontario and Sault Ste. Marie Water, Light and Power Company. The name of the company at the same time being changed to the Lake Superior Power Company.

The Tagona Water and Light Company had already been organized in October of 1894 by Messrs. Clergue and Douglass, and its incorporation was confirmed by the same Act above referred to. This company was assigned the water and lighting privileges in the town of Sault Ste. Marie, and subsequently installed and are now operating an up-to-date water and lighting system.

The new company, viz.: The Lake Superior Power Company, which was composed of Mr. Clergue and his associates, immediately commenced the development of water-power on the Canadian side of the St. Marys falls. They utilized, as far as possible, the old power canal, but increased its size to provide for much larger development of power, and constructed a suitable power-house for the development of electrical power from the water wheels, in which the Tagona Water and Light Company were provided with a pumping and lighting station.

The Sault Ste. Marie Pulp and Power Company was also provided with mill accommodation in the same group of buildings. These buildings are of solid stone construction and of modern type, Lake Superior limestone being used, quarried from the company's own property. This company was incorporated in 1895, and was an allied company of the two others above mentioned, the promoters being the same. It was first planned to make mechanically ground wood pulp under the wet process, but, after manufacturing wet pulp for a time the mill was changed to make dry pulp, and has been operating under this process ever since. The manufacture of pulp marked the commencement of Sault Ste. Marie as a manufacturing town, and consequently a new area of activity.

The promoters of the company mentioned above, realizing the vast natural resources of the district, rapidly proceeded with the inauguration and incorporation of various new industrial and transportation companies, a brief description of which follows. The town and district naturally profited greatly from these developments, entailing as they did the expenditure of vast sums of money for labour and material in their midst.

The Lake Superior Power Company did not confine itself to the development of power alone, but early began the exploration of the surrounding districts for minerals, and met with such success, with respect to iron and nickel finds, as to warrant the construction of plants for the treatment of these ores. Blast furnaces for the smelting of iron ores and a steel rail mill were built, together with operatives' houses; and for the utilization of the hardwoods of the district contiguous to the Soo a charcoal by-product plant and kilns were constructed. The charcoal from these plants was used in one of the blast furnaces. A reduction work was built for the treatment of nickel ore, one of the features of this process being the saving of the sulphurous gas for use

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in the manufacture of sulphite pulp. This company was meanwhile successfully operating the Helen Iron mine and the Gertrude Nickel mine.

The blast furnaces, steel plant and charcoal plant were originally constructed by the Lake Superior Power Company, but in the year 1901 were turned over to the Algoma Steel Company.

The Lake Superior Power Company had also become the owner by purchase, of large areas of real estate in and around Sault Ste. Marie, and particularly on the river front, where it built docks, and otherwise held the land to provide for the expansion of itself and the other allied companies.

The Sault Ste. Marie Pulp and Paper Company built in addition to its ground wood pulp mill a large and handsome sulphite mill, and also commenced the manufacture of building paper and tar paper.

With so much construction and operation going on it was soon found necessary to have a workshop of sufficient capacity to take care of all repairs and a great part of new work. This was started on a comparatively small scale, but the demands upon it were so large that it was later found essential to extend it. This was done from time to time, until finally the Algoma Iron Works was formed, and a splendid modern machine shop with galleries for small work constructed, modern machinery sufficient to do the repairs of all the different departments of the various companies was installed. The blacksmith and tin shops were also added, and an up-to-date foundry for casting iron, brass and copper was built. These are all operating at the present time. This concern not only does repairs for the various companies, but it also handles a great deal of outside work, including marine repairs, of which work it makes a specialty.

Railroad facilities were naturally required to provide for handling ores from the mines and forest products, as well as switching at the various plants, and the Algoma Central Railroad was incorporated August 11, 1901, to serve this purpose, and in addition to a railroad of 120 miles, it owns and operates a fleet of vessels trading out of Sault Ste. Marie, consisting of four passenger boats and six freight boats. As part of the transportation plant of the company, the Manitoulin and North Shore Railway was incorporated July 7, 1901. Both of these railroads were the recipients of land grants from the Ontario government, the conditions of which can be obtained in the statutes.

The construction of these transportation lines was carried on by the Algoma Commercial Company, formed for this purpose, as well as for the purpose of carrying on mining and lumbering operations, the latter operation including the supply of pulp wood through the mill of the pulp company, and that of saw logs and veneer logs to its own saw and veneer mills at the Soo, the saw mill having a daily capacity of 100,000 feet, and the veneer mill being the largest in Canada. This company also built a car building plant at the Soo with a capacity of eight flats or four box cars per day. It further made extensive explorations for minerals, including iron, nickel and gold. The company owns at present the Josephine mine, which is a bessemer iron mine, the Grace gold mine and the Elsie nickel mine.

The right to operate street car lines had also been granted to the companies under the original franchise, and the International Transit Company was formed for the purpose of operating electric street car lines in the town of Sault Ste. Marie, Ontario, and also a ferry on St. Marys river between the two Soos. An up-to-date electric railroad was constructed and is at present operating. The equipment of the company also includes two ferries, the 'Algoma' and the 'Fortune.' These are modern ferry boats and have sufficient capacity to easily handle the traffic.

In the year 1901, the various companies were consolidated under the ownership of the Consolidated Lake Superior Company. The individual companies were made subsidiary to this company in that the Consolidated was a holding company and owned the stock of the various companies, the companies, however, preserving in every way their corporate existence. The subsidiary companies were reorganized in

the year 1904 under the title of the Lake Superior Corporation, which at present is the holding company.

Before the advent of these companies the town of Sault Ste. Marie had a population of 2,000. There were no factories of any kind in the place, and the community did a very small business except a certain amount of trading. The construction of the large factories of the allied companies immediately gave a great impetus to the town. The population has steadily increased, until at the present time it is estimated that the population is 15,000. The works and properties of the allied companies cover an acreage of 1,600 and a total of about 4,000 men find employment. The town is in a prosperous condition, and is certain to become one of the great manufacturing centres of the country.

The following is a list of the various companies with the different plants operated by each, together with the number of men employed:—

Tagona Water and Light Company—

Municipal system of electric lighting and water supply; employs twenty men; eighty-eight miles of electric wire; twenty miles of water main.

Lake Superior Power Company—

Owners of the Canadian Power Plant; nickel reduction works, Gertrude nickel mine and smelter; brick plant; large acreage real estate; Helen iron mine; two hundred and twenty-five men employed.

Sault Ste. Marie Pulp and Paper Company—

Ground wood mill, 110 tons daily capacity; sulphite pulp mill—50 tons daily capacity; building paper and tar paper mill, 20 tons daily capacity; one hundred and seventy-five men employed.

Algoma Iron Works—

Large modern machine shop, blacksmith shop, tinsmith shop, pattern shop, brass, iron and copper foundry; employs one hundred and fifty men.

Algoma Steel Company—

Two blast furnaces, daily combined capacity 450 tons; steel plant, 600 tons steel rails daily capacity; charcoal retort plant, daily capacity 8,000 bushels charcoal, 1,600 gallons wood alcohol, 24,000 pounds gray acetate of lime; thirteen hundred men employed.

Algoma Central and Hudson Bay Railway Company—

One hundred and twenty miles of standard railroad under operation, fully equipped with modern rolling stock; steamship line consists of four passenger and six freight boats, also operates four docks; three hundred and fifty men employed.

Manitoulin and North Shore Railway Company—

Thirteen miles of standard railroad under operation, fully equipped with modern rolling stock, operated between Sudbury and Gertrude mine; thirty men employed.

International Transit Company—

Operates standard electric street car line in the town of Sault Ste. Marie, Ontario, providing eight minute service; also operates ferry service between two Soos, owns two ferries; fifty men employed.

Algoma Commercial Company—

Operates saw mill, daily capacity 100,000 feet lumber; veneer mill, largest in Canada; car building plant, capacity eight flats or four box cars per day; large lumber operations, extensive mining property in districts around the Soo; employs eighteen hundred men.

The site of the power canal of the company is on certain streams between the islands originally existing in the rapids, and the intake is below the crest of the rapids from a natural bay in the river. The canal from the head-gates to the power

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house is 2,200 feet long, and the tail-race from the power house to the dredged channel opposite the north and south docks of the Lake Superior Power Company, is about 1,000 feet long. The canal is trapesoidal in section, with an earth and rock bottom and earth banks, the canal sides of which are paved with riprap. It is about 220 feet wide at the water line and about $12\frac{1}{2}$ feet deep at the head gates, changing gradually to a width of 85 feet and a depth of $15\frac{1}{2}$ feet at the power house. The head gates, which are constructed of wood, are located about 70 feet west of the Canadian Pacific Railway where it crosses the power canal. The power is developed by 42-51 inch vertical turbines, and at mean head is about 15,000 horse-power at the turbine shafts. To develop additional power would require either the enlargement of the present canal or the construction of a new canal. The amount that could be developed depends upon the division of the flow of the river for utilization in United States and Canadian territory. The total flow of water, when all water wheels are running to their full capacity, is about 8,800 cubic feet per second, but the average flow is about 7,000 cubic feet per second.

The compensating works erected by the Lake Superior Power Company at the request of the United States War Department for the waters diverted through the canal of the Michigan Lake Superior Power Company on the American side, are located about 150 feet west of the centre line of the International Bridge, opposite spans Nos. 9 and 10, which are those nearest to the Canadian shore. They consist, as at present constructed, of an earth and rock fill dam opposite span No. 10, and a series of four stone and steel sluice gates opposite span No. 9. These gates leave a clean waterway opening each between stone and concrete piers of 52 feet $2\frac{1}{2}$ inches, and the elevation of the sill of the gates is 591, or about $10\frac{1}{2}$ feet below mean water level. The gates are counter-weighted and operated by hand by means of suitable trains of gears. The cost to date is about \$267,000. The result accomplished by the compensating works with the gates closed is to reduce the flow through the rapids section by about 10,000 cubic feet per second at mean water level of 601.5 feet above mean tide water at New York city. As the gates have not been opened since construction, no data can be given as to the effect on flow under such a condition.

The Lake Superior Power Company claims to have constructed these compensating works under the authority given it by Acts of the legislature of the province of Ontario, and more particularly by section 4 of chapter 88, 52 Victoria, page 311 of the statutes of Ontario, which reads as follows:—

‘After having acquired the land or property necessary for the carrying out of the works hereinafter mentioned, the company shall have the power to erect engines and employ hydraulic power, and for such purposes to erect, construct and maintain a dam or dams across the inland channels or rapids of the St. Marys river, or of any branch thereof within the province of Ontario, and also to conduct water from the said river and the various branches thereof, and streams entering therein by canals or flumes to be made by the company at any place on the said rapids along the shores thereof for hydraulic purposes, and may also construct all necessary locks, piers, wharfs and other works on the canals, and may extend its work into, and take possession of the bed and beach of the said St. Marys river at the entrance of the canals or flumes, and for the foundation of the same and in their entire length, and at any point at which it may be found expedient to provide an outlet or outlets for the waters of the canals or flumes, or tail-races for water-powers taken from the said canals or flumes; the company may, for the purpose of survey, enter upon all lands on the line of the rapids, and from time to time may purchase, acquire, hold and enjoy all lands necessary for all the above purposes, and such ditches as may be necessary along the banks of the said river and streams, or for a road or either or both sides of the river branches, canals and flumes; the company may make all bridges, intersection, crossings whether through, under, or upon public or private roads, or any aqueduct or canal, and may erect all necessary dams, piers, wharfs, raceways, flumes, canals, or other works to secure the necessary supply of water for the works, and may construct and maintain such buildings, mills,

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machinery, tramways, or railways and switches, wharfs and piers, dams, canals, raceways, and other conduits and works as may be requisite or may be deemed advantageous for carrying on the business of the said company; provided that it shall be responsible for all damages arising from inundations, if any, which its dams may cause, and all damages which may be caused by the carrying out or maintenance of any of its works; provided that nothing herein contained shall be held to confer the right of expropriating any land or interest therein, or any water or other privilege, and the provisions of this section, so far as they affect or may affect the rights or interests of the Crown or any individual, shall be taken advantage of and exercised only with the consent of the Crown or such individual in that behalf first obtained.'

The company claims, having been advised by its then solicitor and subsequently by the law officers of the government of Ontario, that the title to and jurisdiction over the lands under the water on the Canadian side of the river and all the riparian rights appertaining thereto, including those of water-power and hydraulic developments, were vested in the Crown, as represented by the province of Ontario, and in the legislature of the province of Ontario, respectively, and as the works were constructed at a point where it was believed the works did not interfere with navigation, counsel for the company at the time advised that no consent or permission from the Dominion government was necessary.

The solicitors of the company further stated that sometime after these works were constructed, and during a visit to Sault Ste. Marie of the Honourable Mr. Tarte, the then Minister of Public Works, and Mr. Coste, late Chief Engineer of the Public Works Department, and at the time employed by said department as supervising engineer of the works in course of construction at Port Colborne, Ont., the compensating works were inspected, and Mr. Coste suggested to Mr. F. H. Clergue, who was then president of the company, to apply to the Dominion government for approval of the works then constructed. The present directors of the Consolidated Lake Superior Power Company now understand from Mr. Clergue that, while not conceding that the action of the company at the time had not been regular and proper, he intended making the application suggested by Mr. Coste, his understanding being that the Minister of Public Works and Mr. Coste were satisfied with the construction, and that it would only be necessary to present a formal application under the statute to obtain the approval of the government subject, of course, to such reasonable regulations respecting the operation of the compensating works as the Minister of Public Works might see fit to impose. Owing to Mr. Clergue's retirement from the management of the company and the subsequent financial difficulties which befell the company, the matter was overlooked, and it only came to the attention of the directors of the present Consolidated Lake Superior Power Company when the sub-committee, in visiting the compensating works at the Soo, asked under what authority they had erected the same. The company has, through its solicitor, filed the formal plans and description of the site with the Public Works Department and with the registrar of deeds at Sault Ste. Marie. The company, while not conceding that its action has been in any way irregular, is quite prepared to accept the approval of the Dominion government, subject to such reasonable regulations as may be imposed respecting the operation of the compensating works.

The application should have been made from the start, in virtue of chapter 92 of the Revised Statutes of Canada, entitled 'An Act respecting certain works constructed in or over navigable waters.'

The engineers of the company report that the mean flow of the St. Marys river, including that through the rapids, power canals and ship canals, has been for the last 24 years about 73,600 cubic feet per second. They further report that it appears probable from the data which they have that the amount of power which can be developed from the flow of the rapids is, commercially speaking, governed not by the mean flow for a period of 24 years, but is that which can be developed from the mean flow from the rapids during years of low water. Under the best conditions that can be obtained with a very complete system of compensating works in the rapids, the flow

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can probably be regulated so as to obtain a mean annual discharge in the years of low water of about 60,000 cubic feet per second.

10. THE CANADIAN SHIP CANAL.

The sub-committee, after having visited thoroughly all the plants and the works of the Consolidated Lake Superior Water-Power Company at Sault Ste. Marie, Ont., re-embarked on board the United States government steamship *Alfred Noble*, for a visit to the Canadian and American locks. Mr. J. C. Boyd, superintendent of the Canadian canal, accompanied the members of the sub-committee.

The length of the Canadian lock between the extreme ends of the entrance piers was, at the end of the season of 1904, 6,767 feet. During the season of navigation of 1905, another 800 feet has been added, which, when completed, will make a total length between the extreme ends of the entrance piers of the Canadian canal of 7,567 feet. There is only one lock of 900 x 60 feet, and it is of solid masonry. The depth of water on sills at lowest known water level is 20·3 inches. But the mean depth on the mitre sills is 22 feet. The total rise or lockage is 18 feet. The breadth of the canal at bottom is 141·08 and the breadth at surface of the water is 150 feet. This canal has been constructed through St. Marys island, on the north side of the rapids of the River St. Mary. The approaches to the canal are channels dredged through boulder shoals. The superstructure of the entrance piers is concrete. The gates and culvert valves are operated by electricity.

On October 13, 1904, the masts for day marks, from which fixed red lights were exhibited to mark the axis of the channel leading to the lower end of the Canadian canal, have been replaced by square, open skeleton, galvanized iron, unpainted towers with sloping sides, surmounted by square wooden lanterns, from which red lights are shown. Each light consists of a group of three incandescent electric lamps, which show strong beams in the line of range and over a small arc on each side thereof. On the channel side of each tower is a white, diamond-shaped day beacon of slatwork.

The front tower is 62 feet high and stands on the shore of the bay north of the entrance to the canal; its light is 63 feet above the water level below the canal and is visible 2·3 miles. The back tower, 72 feet high, is 1,150 feet north of the front light; its light is 78 feet above the river level and is visible 2·3 miles.

To enter the canal from below, the two lights are brought in range opposite the power-house, and kept thus until the axis of the canal is reached.

A railway drawbridge crosses the canal with a drawspan of about 144 feet 5 inches clear width between the canal walls, and 15 feet clear height above low water surface. The draw does not sound any whistle, and the closure of the draw is indicated by the waving of flags from the end of the bridge. Boats sound three whistles as a request for opening the draw if it be found closed. The bridge if closed at night, shows a red light.

The Canadian canal was built between the years 1888 and 1895, and the cost with approaches was \$4,000,000.

The Department of Railways and Canals is making extensive improvements at the west or upper entrance of the canal. The eastern or lowest entrance has been deepened to 21·5 feet and to a width of 315 feet. The south pier was originally only 130 feet long. To this a concrete extension has been built 800 feet long, as above stated, making the total pier length 930 feet. This work was completed during the season of 1904.

During the season of 1905 the west or upper entrance has been deepened to a depth of 21·5 feet, and a width from 300 to 500 feet. The work has been in progress during all summer, under contract. The south pier at the west entrance was originally 1,265 feet in length. To this an extension 800 feet long is now being built, under contract. When this extension is completed the length of this pier will be 2,065 feet.

The first lock which was ever built on the Canadian side of the river was erected by the Hudson Bay Fur Company, in 1798. It was 38 feet long, 8·9 feet wide, with a lift of 9 feet. A towpath was made along the shore for oxen to pull the vessels and

canoes through the upper part of the rapids. This lock, excepting its timber floor and mitre sills, was destroyed in 1814 by United States troops from Mackinaw island, under command of Major Holmes. This lock has been restored and is to be seen near the general offices of the Consolidated Lake Superior Power Company. The Hudson Bay Fur Company also built a block house nearby to protect the locks from the attacks of Indians, and this structure has been restored, and is now one of the attractions of the Soo, for the double reason of its being what it is and because it was the first home of Francis H. Clergue in the Soo.

11. THE UNITED STATES SHIP CANAL.

After this lock, the first of real consequence was the state lock built on the American side by the state of Michigan, from 1853 to 1855. The canal was $1\frac{1}{2}$ miles long, 64 feet wide at the bottom, 100 feet wide at the water surface and 13 feet deep. There were two tandem locks of masonry, each 350 x 70 feet, having $11\frac{1}{2}$ feet on the mitre sills and a lift of about 9 feet each. The locks were destroyed in 1888 by excavations for the present Poe lock. The Weitzel lock, 515 feet long, 80 feet wide in chamber, narrowing to 60 feet, at the gates, was built by the United States in the years 1870 to 1881. It was opened to navigation on September 1, 1881. The depth of water on mitre sills is 17 feet when the upper pool is 601.9 and the lower pool 584.4 feet above mean tide at New York. At the same time the depth of the canal was increased to 16 feet, the mean width to 160 feet, and the stone slope walls were replaced with timber piers, having a vertical face.

The Poe lock, 800 feet long, 100 feet wide, and having 22 feet of water on the sills, was built by the United States in the years 1887 to 1896. Hydraulic power is used for operating the two American locks, a pressure of 115 pounds per square inch being used for the Weitzel lock machinery and a pressure of about 200 pounds for the Poe lock machinery.

A railway drawbridge crosses the canal at a point about 3,000 feet above the head of the locks and about 300 feet above the movable dam. The clear width of draw opening between canal walls or piers is about 114 feet 5 inches, and the clear height of draw above the low water surface is about 15 feet. For passage of trains, the draw sounds one whistle, then closes, then sounds six whistles answered by two whistles from the waiting locomotive. After passage of train the draw is opened without further signal. Boats sound three whistles, as requested, for opening the draw if it be found closed. The bridge, if closed at night, shows a red light.

This bridge is continued across the St. Marys river at the head of the rapids by ten fixed spans, each of approximately 232 feet clear width and 15 feet clear height above water surface.

During the fiscal year ended June 30, 1904, 16,120 vessels passed through the Canadian and the two American locks. These vessels had a total registered tonnage of 24,364,138 tons, and they carried 31,546,106 tons of freight, and 37,695 passengers.

From the opening of the season of navigation of 1905, to November 30, inclusive, the statistics of the traffic through Canadian and American locks are as follows:—

Through the	American locks,	15,614 vessel passages
"	" Canadian "	5,495 " "
"	" American "	9,507 lockages
"	" Canadian "	3,910 "
"	" American "	30,360,448 registered tonnage
"	" Canadian "	5,403,906 " "
"	" American "	37,641,105 tons of freight
"	" Canadian "	5,359,368 " "
"	" American "	28,315 passengers
"	" Canadian "	25,741 "

These figures are from the opening of navigation to and including November 30, 1905.

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The inspection of the ship canals ended the visit of the sub-committee to Sault Ste. Marie. Before separating a resolution was passed thanking the officers of the Corps of Engineers of the United States Army at Sault Ste. Marie, Michigan, and in particular Mr. L. P. Morrison, junior engineer in charge, for the great courtesy they had extended to the members of the sub-committee during their inspection of the conditions at the Soo.

Mr. Clinton left to return to his home in Buffalo, and the Canadian section of the sub-committee proceeded to Duluth via Port Arthur and Fort William, to make a preliminary investigation into the proposed works of the Minnesota Canal and Power Company. They left Friday, August 18, by the Canadian Pacific Railway Company's Steamship *Athabaska* at 3 p.m., and arrived at Port Arthur the following day at 12 noon, covering the distance between Sault Ste. Marie, Ontario, and Port Arthur in about twenty-two hours. The weather being exceptionally fine they had a splendid opportunity of examining thoroughly the conditions of the navigation on Lake Superior, and to obtain valuable information.

12. ST. MARYS RIVER WEST OF THE SHIP CANALS AND WHITEFISH BAY.

Shortly after having left the western end of the Canadian ship canal, the vessel passed near the Vidal shoal, situated at about $1\frac{1}{2}$ miles above the rapids, between the United States and the Canadian channels. The removal of that shoal is of paramount necessity, as it is a source of great danger to vessels, particularly in foggy weather.

The route of the vessels off the Vidal shoal is in a direction southwest up to a point opposite Pointe au Chene, Ontario, where it turns in a direction northwest and follows it in a straight line to Ile Royale. At that point the route makes a little turn to the north, as far as Pie island and Thunder cape, thence proceeding again northwest to Port Arthur.

The ships enter Lake Superior properly at a point opposite Gros cap, Ontario, and Point Iroquois, Michigan. The distance between Sault Ste. Marie and Gros cap is about 30 miles.

13. LAKE SUPERIOR.

Lake Superior is the largest of the great lakes and also the largest area of fresh water on the globe. It is characterized by deep water and by high and rocky shores along a large portion of its coast. Compared with the other great lakes, its surface is more elevated above the sea; it is more irregular in outline, has deeper and colder water, more fog, more ice, a shorter season of navigation, less rain, about the same snowfall, and winds and seas not greatly different.

The prevailing storms on Lake Superior are from the northeast and northwest. During the summer months the perils of navigation are mainly those of fogs and squall winds, the latter occurring almost invariably in connection with thunder storms. In the spring and the autumn the lake is stormy and dangerous.

The length of the steamer track from Point Iroquois to the entrance of Duluth harbour is 383 miles; from Michipicotan harbour, Ontario, to Duluth, in a straight line, the distance is 350 miles. The breadth of the lake (longitude 86 degrees 45 minutes) is 160 miles. According to the report of the Deep Waterways Commission, published in 1897, the area of the water surface of Lake Superior is 38,800 square miles, but according to the calculations of the Canadian Geological Bureau the total area of the water surface, as divided by the boundary line between Canada and the United States is, in the United States 20,870 square miles and in Canada 11,760 square miles, making a total of 32,630 square miles. The total area of the basin is 80,400 square miles, and the area drained is 48,600 square miles. The total land shore area is 49,370 square miles, divided as follows by the boundary line between Canada and the United States: on the Canadian side 31,730 square miles, and on the United States side 17,640 square miles. The maximum depth recorded by the

United States Lake Survey officers is 1,012 feet. According to statistics furnished by the United States Weather Bureau, the average yearly rainfall on Lake Superior is 28 inches the mean surface of the lake above mean tide at New York city, during forty-five years, from 1860 to 1904, is 602.29 feet. The standard high water above mean tide at New York city is 605.32 feet; the standard low water adopted by the United States Lake Survey for the new charts, above mean tide at New York city, is 600.56 feet. The low water datum for harbour improvements above mean tide at New York city is 601.75 feet. The mean level of Lake Superior above the mean level of Lake Huron is 20.89 feet. The discharge of St. Marys river, as measured in 1902 by the United States Lake Survey officers, at the mean stage of Lake Superior (602.29 feet) is 75,000 cubic feet per second. The increase in discharge per foot rise of the lake is 15,500 cubic feet per second. The average date of the opening of navigation at the St. Mary's Falls Canadian canal is April 27, and the average date of the closing of navigation is December 2.

During the year 1904 the monthly mean stages of the lake above mean tide at New York city were as follows:—

	Feet.
January..	602.51
February..	602.32
March..	602.14
April..	603.19
May..	602.51
June..	602.81
July..	602.91
August..	602.99
September..	603.08
October..	603.27
November..	603.21
December..	602.82

The yearly mean stage in 1904 was, therefore, 602.73 feet.

During the season of navigation of 1905, from March to October, inclusive, the mean stages of Lake Superior have been as follows :—

	Feet.
March..	602.05
April..	602.24
May	602.48
June	602.76
July..	603.08
August	603.21
September	603.41
October	603.42

The Canadian government has established storm warning stations at Fort William, Port Arthur and Sault Ste. Marie. At Fort William it consists in a signal mast, a little to the east of the C.P.R. elevators. At Port Arthur a signal mast is to be seen on the inner end of the government wharf, and another signal mast exists on the government wharf at Sault Ste. Marie, Ontario. The United States government has established life-saving stations at the following places:—

Crips, Michigan ; Duluth, Minnesota ; Grand Marais, Michigan ; Marquette, Michigan; Muskallonge Lake, Michigan, near the mouth of Sucker River, 15½ miles easterly of Grand Marais; also at Portage Lake ship canals. Two Hearted River and at Vermillion Point, Michigan.

Compared with others of the Great Lakes, Lake Superior was fairly well provided with natural harbours, and the works of improvement, on the Canadian side as well as on the United States side, have created additional harbours of refuge at

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various points. One class of improved harbours consists of bays of generally deep water, having wide mouths, or openings towards the lake, which have been provided with breakwaters to partially close the natural openings and form the desired protection.

A second class of improved harbours consists of those whose entrances are formed by parallel piers or jetties extending from the shore out across a bar of gravel or sand to the desired depth of water, the primary object being either to confine the current to a fixed and narrow width in order to scour and maintain the channel to the depth needed, or to prevent an improved channel from being filled by drifting sand.

Port Arthur affords an illustration of a dredged channel protected from waves and drifting material by a breakwater pier. In late years deeper channels have been required than could be obtained by the scouring action of the currents alone, and dredging has been resorted to. In the harbours at the mouths of rivers the enlargement of the channels by dredging has reduced the velocity of the outgoing currents and changed their action from that of scouring to that of depositing silt or coarser material, so that further dredging from time to time has become necessary. Therefore the jetty piers now serve only to protect the improved channels from the filling up which would result from the action of storm waves and of the so-called littoral currents.

Among the natural and improved harbours on the Canadian side of Lake Superior, from Gros Cap, at the head of St. Mary's river to Port Arthur, there are Goulais bay, with an average depth of nine fathoms inside and which affords good anchorage and protection from all winds; Gargantus harbour, a small harbour of refuge; about 77 miles from the head of St. Mary's river, which affords anchorage and shelter; Michipicoten harbour, on the northerly shore of Michipicoten bay, and the easterly shore of Lake Superior, which is one of the lake terminals of the Algoma Central Railway; Peninsula harbour, Nipigon bay and Thunder bay, which is a fine sheet of water extending 35 miles in a northeast and southwest direction, with a width of 15 miles northwest and southwest, narrowing at both ends. On its shores, cliffs rise from 1,000 to 1,350 feet out of the lake. The northwest coast of the bay, extending from Port Arthur to its head, may be approached within a mile.

About 25 miles opposite Thunder Cape is Isle Royal. The north shore of this island can be approached with safety within three-quarters of a mile of the general direction of the coast. Right at the mouth of Thunder bay is Pie island, about 900 feet high, eight miles long east and west by four miles wide. Good anchorage from southerly winds is to be found off the north and northwest sides, and from the northerly winds off the south side. The passage between Pie island and Thunder cape, $5\frac{1}{2}$ miles wide, is quite clean. Thunder cape is a very prominent headland, about 800 feet high, marking the coast entrance to Thunder bay. Upon its south end is a lighthouse tower 45 feet high, exhibiting a light revolving white every minute, visible at 14 miles. A steam fog-horn sounds blasts of five seconds every half minute. All parts of the cape may be approached to within 200 yards.

On the northwestern side of Thunder bay is Port Arthur, the western terminus of the Canadian Northern Railroad.

14. PORT ARTHUR AND FORT WILLIAM.

Port Arthur is rendered safe by breakwaters parallel to the shore, the entrance being through a gap marked by a fixed red light, 43 feet high, upon the northern portion of the breakwater. The channel is dredged, and 19 feet may be carried to the Canadian Northern Railway Company's elevator. The inner harbour at Port Arthur is therefore formed by two cribwork breakwaters extending in front of the wharfs on the water front of the town. The more northerly breakwater is 3,654 feet long, and has a general trend south of 25 degrees west from a point outside the elevator wharf at the north end of the town. The lighthouse is on this breakwater, and is

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situated at 31 feet from its south end, showing, as above stated, a fixed red light 43 feet high.

The breakwaters are sunk generally in 17 and 18 feet of water, and have a height of five feet six inches above low water. On the lake side the crib work is made vertical up to about low water line, and from there to the top it is finished with a slope one in one, strongly sheeted and the angles protected by boiler plates. The construction of this breakwater has converted what was formerly a dangerous and exposed roadstead into a safe and commodious harbour.

The main entrance between the breakwater is 366 feet wide and is lighted as above noted. A red gas buoy showing a white acetylene gas light automatically occulted at short intervals, is moored in the prolongation of the dredged channel, 2,575 feet southeast by east of the breakwater light. Mariners find the best water by passing 50 to 100 feet southwest of the buoy and steering to pass the same distance off the northern breakwater, when not less than nineteen feet will be found.

There are two other entrances: The western entrance, 1,800 feet in width and reported in 1899 as 12 to 18 feet deep, and the eastern entrance 250 feet wide and reported in 1899 as 17 feet deep. The depth of water in the basin was reported in 1899 as varying from 14 to 18 feet.

The Pigeon River Lumber Company have at Port Arthur a large saw mill and, besides, several new industries are developing. Port Arthur is connected with Fort William by an electric railway, and both cities have a common telephone system.

Fort William is situated five miles west of Port Arthur, on the west side of Thunder Bay and at a short distance up the Kaministiquia river, described as a broad stream with firm banks and good advantages for lake traffic. Fort William is the great shipping port of the Canadian northwest.

The Kaministiquia river rises in Dog lake, at an elevation of about 719 feet above Lake Superior, and flows southerly and then easterly to the lake, a distance of about 42 miles. Falls and rapids are found along its course down to a few miles above the lake. It bifurcates twice in the vicinity of Fort William and has three mouths, known as Fort William river, McKeller's river, and Mission river. Extensive dredging operations by the Canadian government have deepened and widened the channel over the bar of the mouth, and up the river to Fort William, and provided basins for the use of vessels. The nature of the river is such that sand bars are formed at the mouth each season.

The channel at Fort William is dredged and 19 feet of water may be carried into Fort William, and 16 feet may be found five miles up the river to the coal unloading plant of the Canadian Northern Railway Company.

For the purpose of extending the period of navigation a powerful tug had been employed in the fall of the year of 1904 to prevent the formation of ice on the shoals at the mouth of the river, or to break it loose if formed, and thus keep the channel open for a longer time. The material brought down by the river is fine and appears to consist of clay and light sand. The shoals extending out from the mouth on either of the channels, to the vicinity of the Welcome island, are sandy and have a very gentle slope, so that sailboats may ground half a mile from shore within hailing distance of vessels navigating the channel.

From Mutton island, which is situated a short distance north of the mouth of Mission River, to the shore the water is so shallow that it is scarcely possible for even a row-boat to pass. This shoal appears to be the direct product of the action of the waves and the final result will probably be a bar connecting the island with the shore.

Fort William harbour is well lighted.

A cylindrical gas buoy, displaying a white acetylene gas light automatically occulted at short intervals, is moored at the outer end of the northern edge of the dredged channel.

The axis of the channel is marked by two fixed red range lights. The front tower stands on the east end of the timber facing on the Canadian Pacific Railway coal

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yard, which forms the north shore of the river at that point, and is close to the water's edge; the light is 42 feet above waterlevel. The rear tower stands behind the 'trestles and pockets of the coal plant, by which it is partially hidden from the water, and is 122 feet high and painted red. A day-mark, near top of lantern column, consists of a black square, six feet on a side, with a white diamond in the middle. The light is incandescent electric, 128 feet above lake level, and is visible $12\frac{1}{2}$ miles in the line of range.

The towns of Fort William and Port Arthur afford a most striking example of western progress. The population has doubled in two years. Port Arthur has now 7,000 people, and Fort William 7,500. It is predicted that within five years there will be 50,000 people within the borders of the two cities. This remarkable growth is due to the advantageous situation of Port Arthur and Fort William, and their unexcelled railway and steamship facilities. They are the gateways to the great west, the spout of the hopper from which pours millions of bushels of grain grown on the western prairies and a large proportion of which is transhipped there, to be carried down the lake to Georgian Bay points or to Cleveland, Buffalo, Kingston and Montreal. The facilities for handling this great crop at Port Arthur and Fort William are being increased from year to year. The elevator storage capacity at Fort William and Port Arthur, according to the latest figures, are as follows:—

At Fort William—

	Bushels.
Canadian Pacific Railway Elevators, A and C.... ..	2,750,000
“ “ “ B and E	2,500,000
“ / “ D... ..	3,162,000
<hr/>	
Total.... ..	8,412,000
The Empire Elevator Company, Ltd.. .. .	1,700,000
The Ogilvie Flour Mills Company, Ltd	750,000
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Total at Fort William.. .. .	10,862,000

At Port Arthur—

Canadian Northern Railway, Elevators, A.. .. .	3,500,000
“ “ “ B.. .. .	3,000,000
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Total.. .. .	6,500,000
J. G. King & Co.'s elevators	800,000
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Total at Port Arthur.. .. .	7,300,000

The total amount of wheat shipped at the Canadian Pacific Railway elevators at Fort William for the year ended December 31, 1904, is 22,534,416 bushels. The total amount of wheat shipped out of the same elevators from January 1 to November 21, 1905, inclusive, is 17,511,041 bushels.

On the other hand, the Canadian Northern Railway Company, in a statement furnished December 1, 1905, states that the total storage capacity of its two elevators at Port Arthur is 7,000,000 bushels. The two working houses have a total receiving capacity of 250 cars per ten hours, and a shipping capacity into the vessels of 225,000 bushels per hour.

From the crop of 1904 the Canadian Northern Railway passed 7,024,550 bushels through its elevators, and from the crop of 1905, up to and including November 25, the company received into its elevators at Port Arthur 6,070,002 bushels.

The elevators of the Empire Elevator Company, Limited, was constructed at Fort William in 1904 and completed December 1 of the same year. The wooden working house of the elevator has a capacity of 500,000 bushels, and there is besides a fire-

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proof storage of a capacity of 1,250,000 bushels. The total amount of grain handled during 1904 is 5,000,000 bushels, and during 1905, up to November 30, 6,000,000 bushels.

In 1904 and in 1905 a channel was dredged by the Department of Public Works along the face of the Empire Elevator Company's new dock. When completed this channel will be 140 feet in width, and will have a depth of 22 feet below zero of the new gauge adopted in January, 1904. The channel of the River Kaministiquia from the Mission river to the Canadian Northern Railway coal dock at West Fort William has been widened and deepened in places where shoals were found. During the season of 1904, the sum of \$91,508.92 was spent in this work by the Department of Public Works, and a further sum of \$195,000 was appropriated for the season of 1905.

The Ogilvie Flour Mills Company, Limited, have started to erect at Fort William one of the largest flour mills in Canada, and several eastern concerns are negotiating for locations to start branch factories. It is expected that within the next few years there will be an industrial development at the head of the lakes, second to no other city in Canada.

15. THE WATER POWER AT KAKABECA FALLS.

Another factor of the development at Fort William and Port Arthur will be the availability of electric power from Kakabeca falls, which the members of the Subcommittee took occasion to visit.

Kakabeca falls proper are situated about 16 miles from Fort William. For upwards of a mile above the actual falls, the river tumbles down a succession of rocky inclines, forming the Ecarte rapids, at the head of which a company composed of Montreal capitalists, has constructed the intake of its power canal.

Skirting the valley of the river on its northern bank, the Canadian Northern Railway passes within a quarter of a mile of the falls. The Power Company has been engaged during the whole summer of 1905 in the harnessing of the river as follows:—

From above the Ecarte Rapids a gigantic circular flume or aqueduct is being laid at an elevation which will add another forty feet to the hundred and twenty of the falls, while the lower rapids, below which the turbines are being placed, will add yet another twenty feet, giving a total head of no less than one hundred and eighty feet, higher than all but one of the heads of water at the power development at Niagara, and only falling short of that one by a short space that could be measured by inches. The aqueduct is a huge tube of concrete, ten feet in its inside diameter, the whole structure being strongly reinforced with hoops of steel and bars running in a longitudinal direction, forming a network of steel of six-inch mesh, imbedded in solid concrete. The construction of this aqueduct is unique in American engineering, the only others of a somewhat similar kind being built in France, so that the successful completion of this work may prove to be an important epoch in the solution of engineering problems relating to water-power development.

From the point of intake to the outlet into the main reservoir which is on the brow of a steep ridge overlooking the site of the power house, 180 feet below, this pipe lies practically level for a distance of 7,000 feet, and after being discharged into the reservoir the water is divided and flows through two seven-foot penstocks, which run at a steep incline to the water wheels on the bank of the river.

The construction of the flume will require approximately 35,000 yards of concrete, and the progress of the works has been facilitated in the most material manner by the fact that the ground through which the big pipe runs is largely made of beds of gravel of an excellent quality for the making of concrete, so that the excavation of the shallow ditch in which it lies provides at the same time an important item in the material required for the building of the conduit. At its upper end it will traverse a rocky belt, and it is estimated that 35,000 cubic yards of rock will have to be removed here and the place where the power house is under construction.

Across the Kaministiquia, just below the intake, a dam is being thrown, 20 feet

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in height, there being already a depth of 14 feet in the river at this point. The design of this dam is such as to admit the passage of the maximum flow of water without materially affecting the levels of the upper reaches of the river when it is in flood, while retaining enough to keep the big flume filled to its capacity even when the stream is at its lowest.

The reservoir into which the flume discharges is a massive structure of concrete and steel, from which are fed the two steel penstocks leading direct to the turbine wheels, 180 feet below. Each of these wheels will be capable of developing 7,000 horse-power, the initial development which is now under way being thus 14,000 horse-power.

The plans are, however, being prepared, and the work laid out so as to permit of this being doubled at any time by the building of a second flume and providing two additional penstocks, all the rest of the plant being capable of working to the double capacity. In fact, the present operations are intended to be merely the commencement of a water power development which will be on a very large scale, and the ultimate development may greatly exceed that here outlined, for, if the demand for power at the head of the lakes should exceed the 28,000 horse-power thus provided, there is ample reserve behind to duplicate it, and possibly to multiply this by two again.

From the power house at its point of generation, the electric energy will be transmitted to Fort William along a copper wire, at a pressure of 25,000 volts to the sub-station now being erected in the western end of the town, and from this it will be stepped down to any voltage that may be required by consumers. This sub-station is a plain but massive building of concrete and steel, with a floor area of 5,600 square feet and a height of 40 feet.

Construction on the harnessing of the river is being pushed ahead with even greater rapidity than was anticipated, and with a force of about 700 constantly employed through the winter, the company will have the current transmitted to Fort William by June 1, 1906. A bargain has been struck with the town of Fort William, under the terms of which the town will get 600 horse-power at a flat rate of \$25 per horse-power for a 20-hour service, and the Ogilvie mills will be ready to use power by the spring of next year, the elevator of the company being now operated by electrical power provided by the town plant and generated by steam.

How great will be the effect of this power development upon the future of Fort William as a manufacturing centre for all industries that are seeking to enter the growing markets of the great West, can be readily appreciated. Raw material can be delivered on the docks of Fort William as cheaply as at any port on the lake system, while the railway haul from this point to the places of consumption is short as compared to the distance from the factories of the East, and the rapid settlement of Manitoba and the provinces of the West will, in the near future, make the West one of the most important markets for all kinds of manufactured articles in Canada.

After their visit in the harbours of Port Arthur and Fort William and the surrounding country, the members of the sub-committee went across to Duluth, leaving Fort William on Sunday evening, August 20, on board the steamship *Huron*, of the Northwestern Navigation Company.

Arriving at Duluth the following morning, before noon, they visited the harbour of Duluth.

16. THE HARBOUR OF DULUTH.

The harbour of Duluth and the harbour of Superior are practically the same, and they include all navigable waters lying inside of Minnesota Point and along the fronts of the cities of Duluth and Superior to the city limits of each, embracing the new Duluth canal, Superior entry, Superior bay, Allouez bay, St. Louis bay and St. Louis river as far westerly as the bounds of the city of Duluth.

Before improvement, the bays were broad expanses of shallow water with a general depth of only eight or nine feet, except along the channels, which were deeper

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but variable. The natural entrance to Superior bay from Lake Superior, now called Superior entry (also known as the Wisconsin entrance), was a winding channel over a shifting sand bar, with an available depth of 9 to 11 feet, and difficult to follow.

The United States commenced the work of improvement at Superior entry in 1867, under a plan providing for building two parallel jetties across the bar and dredging a channel between them, and began operations at Duluth in 1871, under a plan providing for the extension of the breakwater commenced by the Northern Pacific Railroad just outside of the northerly end of Minnesota point. The extension was completed for a distance of about 1,000 feet from shore, but the superstructure was destroyed by storms, leaving the cribs submerged.

The Duluth canal was cut through Minnesota point by the city of Duluth in 1870 and 1871, and in 1873 its maintenance and improvement were undertaken by the United States to provide an inner harbour of easy access in place of the exterior harbour, for the formation of which the breakwater had been constructed.

The latest approved project provides for the widening and deepening of channels to a navigable depth of 20 feet, for a new channel in Allouez bay, a new channel in St. Louis bay extending northerly, and a new channel in St. Louis river; for extensive turning and anchorage basins at the junction of various channels; for widening the Duluth canal and rebuilding the piers, and for rebuilding the piers at Superior Entry. The work of widening the Duluth canal and rebuilding the piers was completed in 1901. The extensive dredging contract, under which work was in progress for nearly six seasons, and which involved the removal of over 21,500,000 yards of materials, was completed November 14, 1902.

The work of rebuilding the piers at Superior entry was begun in the spring of 1903. There will be two new piers built of concrete, the south pier 2,960.5 feet, and the north pier 3,418.5 feet in length. The work in the seasons of 1903 and 1904 was upon the westerly half of the south pier, which is located about 70 feet south of and behind the old south pier, the old pier remaining in place while the new one is under construction. About 1,600 lineal feet of the new pier was completed at the close of the season of 1904. The operations of 1905 have been on this line and have not interfered in any way with navigation.

The new piers of the Duluth canal, completed in 1900-1, are of equal dimensions, and the clear width between them at the entrance and for a distance of about 1,250 feet from the outer end is 300 feet, after which they flare out at the harbour end to a width of about 540 feet. Each has a length of about 1,700 feet, and projects about 2,150 feet beyond the shore line.

The foundation cribs extend 22 feet below low water datum and the concrete superstructure rises from 10 to 18 feet above that plane. Riprap has been placed along the base of the piers to prevent undermining by currents. Along channel faces of north and south piers is 16 to 23 feet of water over the riprap, dropping off rapidly to greater depths except for the outer 450 feet of channel face of south pier, where there was formerly a rock embankment; this embankment has been partially removed, leaving a depth of 11 to 16 feet close to the pier, a least depth of 17 feet at 20 feet out, and 23 feet at 33 feet out from pier. The clear width of channel with 23 feet least depth is about 240 feet; depth along mid-channel is at least 25 feet.

One of the principal attractions of the harbour of Duluth is the new Aerial ferry or suspended-car ferry over the Duluth canal. The truss which spans the channel has a clear height of 138 feet above low water datum, 137 feet above ordinary high water, and about 135 feet above the highest recorded stage of water in the harbour. Any vessel on the great lakes can freely pass under the bridge. The car, which is suspended from a trolley or truck running on the overhead track and reaching down to within about 12 feet of the water has been completed and inaugurated last summer. The car is 50 feet long and 31 feet wide, is propelled by an electric motor, which is placed under the floor of the car and turns a drum from which cables lead up to the overhead truck and then along the bridge to either tower.

The car is large enough to carry at the same time street-car, teams and foot

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passengers, the motor is in duplicate, and two independent sources of electric current are available, either of which can be turned on quickly in case the other fails. There is a controller at each end of the car, and the operator is stationed at the forward end of the car. The time required for crossing the channel is $1\frac{1}{2}$ minutes. There is an additional and independent hand gear for propelling the car in case of failure of the electric motor. This moves the car much more slowly, and is used only for the purpose of getting the car away from the channel in case of a breakdown.

The steel bridge is 393 feet long, and the bridge supports at the ground are 78 feet wide. This aerial bridge was completed in 1904, at an expense of \$100,000. It is free to the public and it has a carrying capacity of 25,000 pounds.

17. THE PROPOSED WORKS OF THE MINNESOTA CANAL AND POWER COMPANY.

During their visit to Duluth, the members of the sub-committee had several interviews with persons and companies interested in the proposed works of the Minnesota Canal and Power Company at St. Paul and Minneapolis, parties also interested in the proposed undertaking of said company were interviewed informally and valuable information was obtained.

At the height of land in St. Louis and Lake counties, in northern Minnesota, the waters from Birch lake and White Iron lake, and the streams running out thereof, and the immense watershed thereof, run northward and ultimately into Rainy lake, and from there into Rainy river, passing into the Lake of the Woods. The water from this source forms by computation seven per cent of the water passing out of Rainy lake over Alberton falls at Koochiching. The water system of Rainy river and Lake of the Woods have long been established as a commercial highway. From the Canadian ports of Rat Portage and Fort Francis two large and well equipped passenger and freight lines ply daily during the season of navigation, forming the means of water communication between the Canadian ports of Rat Portage, Rainy River town, Boucherville, Barwick, Emo, Big Forks, Little Forks, Isherwood, Fort Francis, Bears Pass, Seine River and Mine Centre, and forming along a considerable part of such route the only vehicle of passenger and freight communication.

The most important section of the 200 miles of navigation is the Rainy river, flowing through what is rapidly becoming a thickly populated and prosperous valley for some 80 odd miles, with towns rapidly building up at close intervals on its banks, dependent almost wholly on the river route for their mercantile and manufacturing interests. The fine class of steamboats plying on this water is already, in certain portions of the summer, hampered by low water on the rapids and shoals of the river, and the proprietors of the regular steamboat lines have been earnestly petitioning for such improvement being made on the river as would remove such disability, a disability that compels the withdrawal, for considerable intervals during each summer, of some of the large and deeper draught steamboats. In view of the fact that navigation is already suffering for lack of adequate water in portions of Rainy river and in portions of Rainy lake, the population of that district has learned with surprise and alarm that active steps had been taken by the Minnesota Canal and Power Company, of Duluth, Minnesota, to obtain the authorization of the Federal government of the United States, through the Commissioner of the General Land Office at Washington, to construct a dam or dams and canal to divert all the waters of Birch lake and White Iron lake watershed, hereinbefore referred to, into the Embarrass river, and by it into Lake Superior at Duluth, thus diverting from this long-established international waterway of Rainy lake and Rainy river a large proportion mentioned of its tributary waters. It is claimed that, if permission be given by the Federal government of the United States to the project of the Minnesota Canal and Power Company, a disastrous injustice will be done to Canadian and American established navigation companies that are now using the water highway of Rainy lake and Rainy river, and to the manufacturing towns along the river, both on the Canadian and United States sides.

It is claimed that the waters of Birch lake and Birch river and White Iron lake

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help to form the chain of lakes and rivers along the boundary which are referred to in the Webster-Ashburton treaty, and which, by the terms of that treaty, are a public highway, free to the citizens and subjects of both countries. The scheme of the Minnesota Canal and Power Company is to take 600 cubic feet per second out of a total estimated average flow of 985 cubic feet per second. The minimum flow is estimated at 210 cubic feet per second. The quantity to be taken, 600 cubic feet per second, would be more than the natural flow during the greater part of the year.

The corporation of the town of Fort Francis on March 17, 1904, sent to the Minister of Marine and Fisheries of Canada a protest against the proposed undertaking of the Minnesota Canal and Power Company. This protest has been sent by the Canadian government to the United States government through the British Embassy at Washington.

On January 25, 1905, the Acting Secretary of State, F. B. Loomis, informed the Right Honourable Sir H. M. Durand, G.C.M.G., the British Ambassador at Washington, that the United States Secretary of the Interior had directed the Commissioner of the General Land Office, before whom the application of the Minnesota Canal and Power Company was pending, to suspend further action in the case until advised as to the result of the inquiry which was to be made by the International Water Boundary Commission. This clearly meant that, in the opinion of the United States government then, the case of the Minnesota Canal and Power Company was to be investigated and reported upon by the International Waterways Commission. Later on, somewhere in the month of March, 1905, the Attorney General of the United States, called upon to give his opinion on the construction to be put upon the Act of Congress authorizing the appointment of the commission, stated in reference to the case of the St. John river, New Brunswick, that the jurisdiction of said commission was limited to the system of the Great Lakes and the St. Lawrence river.

The members of the sub-committee informed the various parties they interviewed at Duluth, Minnesota, and at St. Paul and Minneapolis, that the Canadian section of the commission was willing to take up the case of the Minnesota Canal and Power Company, according to instructions received by them from the Canadian government, but that the American section had expressed doubts as to whether or not they had the power to deal with it.

18. WORKS OF THE ONTARIO AND MINNESOTA POWER COMPANY, KOOCHICHING FALLS.

Since the Minnesota Canal and Power Company made this application to the United States Secretary of the Interior, the Rainy River Development Company and the Ontario and Minnesota Power Company have constructed extensive works at Koochiching falls for the purpose of improving navigation in Rainy lake and Rainy river, with the expectation of using the power which will be developed for manufacturing purposes. The Ontario and Minnesota Power Company, under a contract with the Ontario government, had acquired the Canadian end of the Koochiching falls, and a number of acres of shore land adjacent. They have obtained during the last session of parliament an Act of incorporation, being chapter 139, and entitled 'An Act respecting the Ontario and Minnesota Power Company.'

By an Order in Council, approved by the Governor General on September 19, 1905, the Minister of Public Works and the Government of Canada have approved the plans of the Ontario and Minnesota Power Company. The engineers of the Department of Public Works stated that in so far as the construction of the dam at Koochiching Falls is concerned, it will in no way interfere with navigation above or below the fall at Fort Francis, but will, in fact, be an improvement. The dangerous rapids, two miles above Fort Francis, will be flooded, thereby improving materially the navigation. The freshet waters stored in Rainy lake could be let out, during the season of low water, thereby also considerably improving navigation of the river between Fort Francis and the Lake of the Woods. The only objection that could be raised to the proposed elevation of the dam is provided for by a proposed revetment wall to

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be constructed by the company, and also by a clause in the Act of incorporation of the company, which makes all damages to lands caused by their works a charge to be borne by them.

The proposed works of the Minnesota Canal and Power Company would interfere with the works authorized by His Excellency the Governor General in Council. It is expected that soon after the present session of Congress, the International Waterways Commission will take up this question.

19. THE HARBOUR OF CHICAGO, AND THE CHICAGO DRAINAGE CANAL.

The members of the sub-committee left St. Paul on Wednesday evening, August 23, for Chicago, in view of making a visit to the Chicago Drainage Canal, and a preliminary investigation on a question presented to the Commission at its meetings of June 14 and 15 in Toronto, viz.: 'The effect of the diversion by the Chicago Drainage Canal of 10,000 cubic feet per second on the levels of Lakes Michigan, Huron, Erie and Ontario, and on the River St. Lawrence.'

The first day of their visit to Chicago was spent in making an inspection of the harbour of Chicago and of the large improvement works constructed therein by the United States government.

As stated in the reports of the engineers of the United States War Department, the harbour of Chicago originally could be used by none but the smallest craft, and then only when temporarily deepened by scour due to freshets. Before improvement by the government, Chicago river made a sharp turn to the southward upon approaching the lake shore, to which it ran parallel for a considerable distance before emptying into the lake, being separated from the latter by a long, narrow sand spit.

The first improvement was undertaken by the government in 1833, and consisted in cutting through the sand spit at the point where the river made a sharp turn to the southward, in protecting the banks of this cut by pile pier revetments, which have been extended from time to time, and in aiding the natural scouring of the channel between the piers by dredging. In 1870, to provide a safe anchorage ground for vessels loaded for departure, but detained by gales, or for others seeking shelter at such times, also to provide facilities for relieving the overcrowded condition of the river, and to protect the wharfs and slips proposed to be constructed along the lake front between Randolph and Twelfth streets, the easterly breakwater was projected, and later the southerly breakwater. In 1878, to facilitate entrance to the harbour, and to provide a sheltered anchorage ground in deep water during severe northerly storms, the exterior breakwater was proposed. The works of improvement, include dredging harbour entrance and a portion of basin to a depth of from 21.8 to 22.8 feet; improving the piers at the mouth of the Chicago river, and extending the easterly, southerly, and exterior breakwaters.

The exterior breakwater is about a mile northeast of the entrance to the river; it is 5,413 feet long, 30 feet wide, and was constructed between 1880 and 1889 in water varying from 18 to 32 feet in depth. It has proved a decided benefit to navigation. The harbour of refuge between this breakwater and the entrance to the river has a depth of 18 to 32 feet. The easterly breakwater is about 4,037 feet long, with a shore return at the north end 300 feet long. The southerly breakwater begins about 750 feet south of the southerly end of the easterly breakwater, and is about 3,000 feet long. The easterly and southerly breakwaters, with the south pier to the north and the shore to the west, form the outer basin. The construction of the proposed wharfs and slips along the lake shore from Randolph street to Twelfth street, having been delayed from year to year by the lake from litigation, and finally abandoned, and a bulkhead was built in 1896 along the dock line established by the Secretary of War in August, 1871, and September, 1890; the area west of the bulkhead has been designated as a public park and is being gradually filled in, thereby reducing the area of the basin to 270 acres. Its length is about 7,300 feet, and its greatest width is about 2,000 feet. The basin for 1,150 feet width along easterly breakwater and 3,000 feet

length southward from south pier, has been dredged to 32.8 feet depth. The undredged portion of the basin is very irregular in depth, varying from 12 to 20 feet at low water.

Chicago is divided into three sections by the Chicago river with its two branches. This river is a mile long and presents a busy appearance with vessels docked all along its banks.

One of the interesting features of Chicago is the Drainage canal, which unites the Chicago river and the Mississippi river system, and saves the lake from being polluted by the drainage of Chicago's sewerage system. This canal cost \$34,000,000.

The following dimensions of the Drainage canal are furnished by the officer in charge: Distance from mouth of Chicago river to junction of main channel of canal, with the west fork of south branch of Chicago river at Robert street, about six miles. Length of main channel, Robey street to controlling works at Lockport, 28.05 miles. Dimensions: Robey street to Summit, 7.8 miles, 110 feet wide at bottom, 198 feet wide at water line, with minimum depth of water, 22 feet; Summit to Willow Springs, 5.3 miles, 202 feet wide at bottom, 290 feet wide at water line, with 22 feet depth of water; at Willow Springs the channel narrows to the walled bottom, 162 feet rock cross-section, extending 14.95 miles to Lockport, 160 feet wide at bottom, 162 feet wide at top. This canal is not yet entirely completed. It was designed to take up eventually a volume of 10,000 cubic feet per second. This represents about five per cent of the flow over Niagara Falls, which is about 222,400 cubic feet per second. The Chicago Drainage canal, when completed, will, according to a calculation furnished by the engineer of the Canadian section of the commission, lower the level of Lake Huron by six inches and the level of Lake Erie by four and a half inches. But the Chicago Drainage canal takes now less than half of the volume originally contemplated.

The United States War Department, in its power of conservancy to protect the navigation in the Chicago river, has, December 5, 1901, limited the volume of water which can be taken through it into the Chicago Drainage canal, to 250,000 cubic feet per minute throughout the 24 hours of the day, which is about 4,166 cubic feet per second. If the original plans of the Chicago Drainage Canal are carried out, and it seems likely that this will be done, it will eventually take out, as above stated, 10,000 cubic feet per second.

20. LAKE MICHIGAN.

The city of Chicago has a frontage of thirty miles along the shore of Lake Michigan, which is the only one out of the five great lakes having its entire shores in United States territory.

The area of the water surface of Lake Michigan is 22,400 square miles: its drained area is 45,700 square miles, and the total area of its basin is 68,100 square miles. The average annual rainfall on Lake Michigan is 33 inches. The maximum depth recorded by the United States Lake Survey officers is 870 feet. The steamer track on the lake from Chicago to the Strait of Mackinac is 321 miles. The mean surface of the lake above mean tide at New York city during 45 years (1860-1904) is 581.35 feet. The standard high water (of 1858) above mean tide at New York city is 584.69 feet, and the standard low water above mean tide at New York city is 578.51. The mean surface of Lake Michigan below the mean surface of Lake Superior is 20.94 feet. The average date of opening of navigation at the Strait of Mackinac is the 17th of April, and the average date of closing of navigation at the same place is January 9.

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The following list gives the monthly mean stages of the lake, above mean tide at New York city, during the year 1904:—

January..	579.90 feet.
February..	579.86 “
March..	580.14 “
April..	580.59 “
May..	580.95 “
June..	580.34 “
July..	581.38 “
August..	581.23 “
September..	581.19 “
October..	581.05 “
November..	580.75 “
December..	580.37 “

The yearly mean stage in 1904 was 580.65 feet.

During the season of navigation of 1905 the monthly mean stages of Lake Michigan have been as follows:—

March	580.31 feet.
April.....	580.60 “
May.....	581.03 “
June..	581.36 “
July..	581.49 “
August..	581.46 “
September..	581.40 “
October.....	580.94 “

Lake Michigan is navigable in winter. This navigation is of importance and is increasing.

At the present time there are the following regular winter lines of steamers:—

Two lines from Milwaukee to Racine and Chicago.

One line from Milwaukee to Sturgeon Bay canal and intermediate ports.

One line from Milwaukee to Grand Haven.

One line from Milwaukee to Ludington.

One line from Manitowac to Ludington.

One line from Manitowac and Kewaunee to Frankfort.

One line from Frankfort to Manistique.

One line from Northport to Manistique.

Efforts have been made to maintain a regular winter line from Frankfort to Menominee via Sturgeon Bay canal or ‘Death’s Door,’ but as yet they have not proved successful.

21. DETROIT RIVER AND LIMEKILN CROSSING.

The members of the sub-committee left Chicago on Saturday, August 26, for Detroit, so as to make an inspection of the Detroit river, which unites Lake St. Clair to Lake Erie.

After a visit to the office of the United States Lake Survey, in the Campau Building, where valuable information and important documents bearing on the work entrusted to the commission were obtained, a trip down the Detroit river was undertaken. First of all, it will not be out of place to give here a description of the river as furnished by the engineers of the United States War Department at Detroit, viz.:—

‘The Detroit river has two characteristic sections, the upper or undivided portion and the lower or divided portion. The upper or undivided portion runs from Lake

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St. Clair to the head of Fighting island, a distance, by steamer track, of 13 miles. At this point the river is divided by islands into several channels, which do not reunite at the mouth of the river. The distance from the head of Fighting island to Bar Point Shoal lightship by steamer track is $15\frac{1}{4}$ miles, making the total distance from Lake St. Clair to Lake Erie $28\frac{1}{4}$ miles.'

The discharge through the upper or undivided portion of the river is 208,600 feet per second when Lake Erie is at a stage of 572.61 feet above mean tide at New York. The increase of the discharge per foot rise of the lake is approximately 21,000 cubic feet per second.

Throughout the upper portion of the river the mean current velocity is about $1\frac{1}{2}$ miles per hour; but at Limekiln crossing, near the mouth of the river, the mean velocity is about $2\frac{1}{2}$ miles per hour, with a maximum velocity of about five miles per hour. For the northerly 16 miles, the river bottom is of earth and the channel banks are usually quite steep, but at the southerly portion the river bottom consists mainly of bed rock and boulders, and the channel banks usually are more sloping. In the upper portion of the river there are two islands—Isle aux Peches and Belle Isle; there is deep water on each side of islands.

Originally the channel at Limekiln crossing could not be depended on for more than 13 feet of water, the ordinary depth being much affected by the direction of the wind. It was in 1874 that the United States government started work of improvement at this point, and they consisted of a curved channel of 300 feet wide, with a uniform depth of 20 feet. In 1883 it was determined to modify the project so as to secure a straight channel, the least width of which should be 300 feet with a somewhat greater width at either end. In 1886 this was further modified so as to increase the width to 400 feet by removing an additional 100 feet from the western side. In 1888 a further additional width of 40 feet on the western side was authorized. This 440 foot channel was completed during the fiscal year ended June 30, 1891. The estimated cost of a 400 foot channel was \$1,374,500. The total amount expended up to June 30, 1891, was \$702,122.04 for a channel of 440 feet.

In 1899 the United States Congress made provisions in the River and Harbour Act for a channel of 21 feet deep from Detroit to Lake Erie. The distance from Detroit to deep water in Lake Erie is about 24 miles, but the section of the river which required any considerable improvement to secure a safe and convenient channel 21 feet deep, was from near the upper end of Grosse Isle to the Detroit River lighthouse in Lake Erie. All improvements made up to 1900 have been confined to this section of the river. The improved channel passed east of Grosse island, Bois Blanc island and was in Canadian waters according to the international boundary line established by the treaty of August 9, 1842. That channel was not a convenient one for the enormous commerce coming through it. The United States War Department decided to make further improvements, and in the River and Harbour Act of June 13, 1902, the works now in way of construction were authorized. The plan was to continue operations in the channel then under improvement, so as to complete it with a low water depth of 21 feet and a minimum width of 600 feet, the side line of excavation being so located as to make the channel as straight as practicable, and especially to eliminate the dangerous bends between the head of Limekiln crossing and Bois Blanc island. The width of the channel, when completed, will be 800 feet opposite Bar point, and will be continued at that width out into Lake Erie. The cost of this excavation was at first estimated to be from \$1,750,000 to \$2,000,000, but the final estimate exceeds the original approximate estimate by nearly \$2,000,000.

During the season of navigation of 1905 the Ballards Reef channel had a clear depth of 21 feet and a width of 600 feet. At Limekiln crossing, the width of the channel available to navigation was 420 feet, with a least depth of 19 feet. In the Bois Blanc Range channel there was a clear depth of 20 feet and a width of 600 feet. The Amherstburg Beach channel has also a clear depth of 20 feet, but it is only 250 feet wide. The Hackett Range channel has a least depth of 19 feet, with a width of 500 feet for the greater part of its length. During the season of 1905 the west half

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of the channel was partly obstructed by improvements in progress. The Bay Point shoal channel extends to the Detroit River lighthouse and is 800 feet wide, with a depth of 20 feet.

The United States government has proceeded with the improvement of the Detroit river without reference to the international boundary line between the United States and Canada, and this since 1874 to the present time. In 1892 and 1893 there were negotiations between the government of Canada and the government of the United States in regard to the improvement made by the United States engineers at the Limekiln crossing. Mr. W. J. Thompson, C.E., made, under the direction of the Minister of Railways and Canals, a report on the subject, and pointed out that the maps of the Commissioners appointed under the treaty of Ghent (1814) place the improved channel at the Limekiln crossing exclusively in Canadian waters. This view, however, was not adopted by the Chief of Engineers of the United States Army, who, in a report dated November 14, 1888, had already stated that 'all the channels opened by the United States at the Limekiln crossing were in American waters, except the extreme northeast and southeast corners of the cut.' By article VII. of the treaty of 1842, it was provided as follows:—

'It is further agreed that the channels in the River St. Lawrence on both sides of the Long Sault islands and of Barnhardt's island, the channel in the River Detroit on both sides of the island of Bois Blanc, and between that island and both the American and Canadian shores, and all the several channels and passages between the various islands lying near the junction of the River St. Clair, with the lake of that name, shall be equally free and open for the ships, vessels and boats of both parties.' This provision, while disposing, by the concession of mutual rights in the channels, of the difficulties of boundary at the islands named, does not affect the boundary line south of those islands, nor does it affect the Limekiln crossing, which lies north of them. This is the view taken by the Canadian government in 1893, when the United States government made application to be allowed to proceed with the improvement of the Limekiln crossing in Canadian waters. The government of Canada in 1875 had itself assisted to the extent of \$5,000 in the works of improving the navigation of Detroit river, and on August 8, 1893, the Governor General in council gave authority to the United States to proceed with the work of removing obstructions in the river, irrespective of the boundary line, such authority to be understood expressly as being given without prejudice to the possessory rights of Canada as defined by the maps and declarations of the Commissioners under the treaty of Ghent. This makes of the Limekiln crossing a channel common to both countries.

In concluding, it might be interesting to give a comparison between the freight traffic of the Detroit river, the Soo and Welland canals.

In regard to the traffic of the Detroit river, it may be said it has been comparatively measured, for the first time, during the past season of navigation. The compilation of the figures is founded on reports of masters of vessels, which are filed with the United States Department of Commerce and Labour through its Bureau of Statistics, and it covers the season of lake navigation of the calendar year 1905. The results are shown as follows:—

Month.	South Net Tons.	North Net Tons.	Total Net Tons.
April..	1,575,877	792,711	2,368,588
May..	4,551,972	1,352,524	5,904,496
June..	5,523,021	1,780,541	7,303,562
July..	5,911,625	1,941,534	7,853,159
August..	6,300,003	2,314,810	8,614,813
September..	4,597,640	1,493,059	6,090,699
October..	5,582,689	1,522,905	7,105,594
November..	4,593,752	1,578,375	6,172,127
December..	1,354,506	871,542	2,226,048
	<hr/> 39,991,085	<hr/> 13,648,001	<hr/> 53,639,086

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The south-bound movement is nearly three times as great as that in the opposite direction. This is largely due to the enormous east-bound tonnage of iron ore from upper lake ports to ports along the southern shore of Lake Erie, whence it is shipped by rail to the great iron and steel districts of southern Pennsylvania. The freight carried in a southerly direction through Detroit river during the past season of lake navigation is divided as follows:—

	Tons.
Flour..	3,176,928
Ore and minerals, exclusive of coal, of which there was no south-bound movement..	32,900,685
Lumber..	1,851,324
Unclassified freight..	971,151

The north-bound movement is divided as follows:—

Coal..	11,928,158
Grain and flax seed..	6,178
Ore and minerals..	415,533
Lumber..	11,940
Unclassified freight..	1,286,192

The traffic through the Soo canals, which connect Lake Superior with the other great lakes, and through the Welland canal, which performs the same duty for Lake Ontario, has largely increased during the past season of navigation. Here follows a statement showing the traffic through the canals at Sault Ste. Marie, for the years 1896 to 1905, inclusive:—

Season.	South Net Tons.	North Net Tons.	Total Net Tons.
1896.. . . . .	.....	.....	16,239,061
1897.. . . . .	.....	.....	18,982,755
1898.. . . . .	.....	.....	21,234,664
1899...	20,619,534	4,636,276	25,255,810
1900..	20,532,493	5,110,580	25,643,075
1901..	23,087,742	5,315,323	28,403,065
1902..	30,275,989	5,685,157	35,961,146
1903..	26,932,238	7,742,199	34,674,437
1904..	24,213,902	7,332,204	31,546,106
1905..	36,778,738	7,491,942	44,270,680

During the season of lake navigation of the calendar year 1905, the total freight movement through the United States canal amounted to 38,802,190 tons, while that through the Canadian canal totaled 5,468,490 tons.

It will be seen that, during the lake season of 1905, the difference between the amount of freight carried, respectively, through the Detroit river and the two Soo canals is 9,368,406 tons in favour of the former. This may be said to represent, at least with a fair degree of accuracy, the traffic through the Straits of Mackinac, which consists largely of shipments of grain and flour from Chicago and iron ore from Escanaba, while the west bound cargoes consist largely of coal and package freight.

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The following table represents the volume of traffic between Lake Erie and Lake Ontario by way of the Canadian Welland canal, which runs parallel with the Niagara river :—

Season.	Down tons.	Up tons.	Total tons.
1894.. .. .	745,942	243,592	989,534
1895.. .. .	621,926	230,100	852,026
1896.. .. .	957,928	285,667	1,243,595
1897.... .	1,026,458	218,292	1,244,750
1898.... .	902,590	218,211	1,120,730
1899.. .. .	622,104	147,514	769,618
1900.. .. .	579,312	109,245	688,557
1901.. .. .	501,935	89,311	591,236
1902.. .. .	567,286	78,811	646,097
1903.. .. .	715,595	263,212	979,807
1904.. .. .	620,078	182,402	802,480
1905.. .. .	848,007	227,961	1,075,968

Respectfully submitted,

(Signed) THOMAS COTE,
Secretary.

OTTAWA, December 1, 1905.

APPENDIX A1.**INTERIM REPORT OF THE AMERICAN SECTION.**

INTERNATIONAL WATERWAYS COMMISSION

(Office of American Section),

328 FEDERAL BUILDING,

BUFFALO, N.Y., December 1, 1905.

MR. SECRETARY,—1. The American section of the International Waterways Commission has the honour to submit the following progress report :—

2. The River and Harbour Act, approved June 13, 1902, contained the following provision, viz. :—

‘Section 4. That the President of the United States is hereby requested to invite the Government of Great Britain to join in the formation of an international commission, to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, including all of the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean ; also upon the maintenance and regulation of suitable levels, and also upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation by reason of the diversion of these waters from or change in their natural flow ; and, further, to report upon the necessary measures to regulate such diversion, and to make such recommendations for improvements and regulations as shall best subserve the interests of navigation in said waters. The said Commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof. The President, in selecting the three members of said Commission who shall represent the United States, is authorized to appoint one officer of the corps of engineers of the United States Army, one civil engineer well versed in the hydraulics of the great lakes, and one lawyer of experience in questions of international and riparian law, and said Commission shall be authorized to employ such persons as it may deem needful in the performance of the duties hereby imposed ; and for the purpose of paying the expenses and salaries of said Commission, the Secretary of War is authorized to expend from the amounts heretofore appropriated for the St. Mary’s river at the Falls the sum of twenty thousand dollars, or so much thereof as may be necessary to pay that portion of the expenses of said Commission chargeable to the United States.’

3. The invitation here authorized was duly communicated to the Government of Great Britain by the American Ambassador in London by letter dated July 15, 1902 (copy appended, marked ‘A,’ page 16), and was accepted by letter from the British Foreign Office, dated June 2, 1903. The American members were appointed October 2, 1903 ; they were Colonel O. H. Ernst, Corps of Engineers, United States Army ; Mr. George Clinton, of Buffalo, N.Y., and Prof. Gardner S. Williams, of Ithaca, N.Y. The Canadian members were appointed on January 7, 1905 ; they were Mr. W. F. King, Chief Astronomer, of Ottawa ; Mr. J. P. Mabce, K.C., of Toronto, and Mr. Louis Coste, C.E., of Ottawa.

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4. The American section held its first meeting in Washington, D.C., May 10, 1905, and organized by the election of Colonel Ernst as chairman. The scope of the investigations to be undertaken was defined in a letter from the Department of State, dated April 15, 1905 (copy appended, marked 'K,' page 19), from which the following is an extract, viz. :—

'The wording of the law will be seen by reference to the inclosed copy. The department's opinion is that the words "including all of the waters of the lakes and rivers whose natural outlet is by the River St. Lawrence to the Atlantic ocean," are intended as a limitation on what precedes them, and that the investigation and report should only cover such waters, omitting the lower St. Lawrence itself, as well as all other waters not discharging naturally through it.

'The broader interpretation given to the Act by the Canadian authorities should be rejected, if for no other reason, on account of the smallness of the appropriation for the support of the American section. Congress could hardly have intended to provide, with a sum of \$20,000, for the expenses incident to an investigation extending to the Pacific coast, and possibly embracing the Alaskan boundary as well.'

It was learned informally that the British government objected to this limited interpretation of the law and had requested a reconsideration of the question, and that the matter had been referred to the Attorney General. In a conference with the Honourable Secretary of War, it was decided that the work of the commission should be under the War Department. It was also decided to invite the Canadian members to join in the first full meeting of the commission in this city, to be held May 25, and an invitation was issued accordingly by the Department of State at the request of the Secretary of War.

5. On May 25 the full commission held its first meeting in this city, and organized by the election of Colonel Ernst as chairman of that meeting, it being agreed that at meetings of the full commission held on American territory the chairman of the American section should preside, and at meetings held on Canadian territory the chairman of the Canadian section should preside. The commission remained in session during the 25th and the following day, discussing the organization, permanent place of meeting, and scope of their duties. It was decided that for the present the offices of the Canadian section should be established in Toronto, and those of the American section in Buffalo, and that full meetings should be held in one or the other city, as should be found most convenient.

6. The American section, having presented the instructions under which they were acting, quoted above, the Canadian section presented the following memorandum, viz. :—

'The Canadian members of the International Waterways Commission had understood the scope of the commission to be wider than the American members regard it, and that any misunderstanding may be avoided desire briefly to state the position they have understood matters to be in.

'The invitation to His Majesty's government, through the American Ambassador in London, was "for the appointment of an international commission, to be composed of three members from the United States and three who shall represent the Dominion of Canada, whose duty it shall be to investigate in general the waters adjacent to the boundary line between the United States and Canada, the effect upon the shores produced by changes in the water levels, and the erection and location of a dam at the outlet of Lake Erie."

'In due course, by a report of the Committee of the Privy Council of Canada, approved by the Governor General of Canada, it was resolved "that His Majesty's government accept the invitation to co-operate in the formation of the commission." This report, after further reciting that as the subjects to be dealt with pertained to "the regulations of the waters adjacent to the international boundary," the matter, in so far as Canada was concerned, should be under the Department of the Interior and the Department of Public Works.

'Some regrettable but unavoidable delay in completing the Canadian section of

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the commission arose by the long-continued illness of the Honourable the Minister of Public Works for Canada.

‘In the despatch to the government of Great Britain naming the American Commissioners, the invitation to His Majesty’s government is again recited as being one to form an international commission to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada.

‘After the appointment of the Canadian Commissioners, the Prime Minister of Canada, Sir Wilfrid Laurier, in communicating the matter to the Canadian House of Commons, in January last, dealt with the subject-matter of the commission as covering all waters adjacent to the boundaries of the two countries, and in the course of his speech made the following statements: “In sections of the country where the boundary is not water, but land, there are streams and large rivers which have their sources in one country and which flow into another. Complaint has been made by the United States that Canadians have constructed some works upon rivers which have their sources in Canada and which flow into the United States, and that these works affect the flow of the waters in their country. We also have made complaints to the United States that Americans have constructed upon some rivers, the St. John river, for instance, works which affect the flow of the waters in our country. It is, therefore, to the mutual interest and advantage of both countries to have this question properly investigated with a view of having concurrent legislation, if such should be found necessary. From olden times it has been a principle of Roman law, which has been adopted by most civilized nations, that the riparian owner of any stream has the right to use the water of that stream for his own benefit, provided he does not impair the flow of the water beyond the boundary of his property. This is a principle of law which dominates in almost every country; but it is not possible to have this principle followed and carried out when the works are in one country and the boundary of the property is in another country. For these reasons we have thought it advisable to respond to the invitation of the United States to have this question investigated. We have agreed to a commission to be composed of six members, three to represent the government of the United States and three to represent the government of Canada.”

‘If the inquiries of the commission are to be limited to the waters of the Great Lakes only, it would seem that the government of Canada has been under misapprehension as to the desires and intentions of the government of the United States, and we regard it as our duty to report to our government the limitations expected to be placed upon the scope of the commission, and we respectfully suggest that further action should be delayed until we may be advised of the views of the government of Canada upon the premises.’

7. The chairman of the American section stated that he was informed that the British government had communicated with the American government, through diplomatic channels, requesting that the broader interpretation above described be given to the law of congress providing for the commission, and that the American government then had the matter under consideration, but that some days would probably elapse before a decision could be expected. It was then decided that further proceedings be deferred until further instructions be received from the two governments. It was agreed that the decision of the American government should be communicated to the chairman of the Canadian section as soon as received, and that if it be favourable to the Canadian interpretation of the law, or if it be unfavourable, and be accepted by the Canadian government, then a meeting of the commission should be called on Canadian territory by the chairman of the Canadian section at as early a date as the other duties of the members would permit.

8. The decision of our government was given in a letter dated May 31, 1905, from the Department of State to the British Ambassador at this capital (copy appended, marked ‘E’ page 17), and was in effect to leave the instructions to the American members unaltered. It was immediately communicated to the Canadian section by letter, dated June 2, 1905 (copy appended, marked ‘R,’ page 27), and was by them

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laid before the Canadian government, which government, after due consideration, authorized the Canadian members to proceed with the work of the commission within the field prescribed to the American members. See letter from the chairman of the Canadian section, dated June 7, 1905 (copy appended, marked 'S,' page 27).

9. The American section then proceeded to complete its organization. Through the courtesy of the Honourable Secretary of the Treasury, excellent quarters in the Federal Building, in Buffalo, were assigned to its use, completely furnished and arranged with temporary partitions to suit its convenience in every respect. These rooms became available September 11. The section was fortunate enough to secure the services, as secretary, of Mr. L. C. Sabin, a hydraulic engineer of many years experience on the Great Lakes in the service of the government. He reported for duty August 1. Professor Williams, finding that business engagements, contracted since his appointment in October, 1903, would interfere with his performance of duty as a member of the commission, tendered his resignation, and was replaced by Mr. G. Y. Wisner, civil engineer, appointed June 8, 1905.

10. The full commission held its second meeting at Toronto, June 14 and 15, 1905. Among the questions brought to the attention of the commission at this meeting were the following, viz.:—

(a) The uses of the waters at Sault Ste. Marie for power purposes, and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of the navigation interests.

(b) The uses of the waters in the Niagara river for power purposes, and the regulations necessary to insure an equitable division of the waters between the two countries, and the protection of Niagara falls as a scenic spectacle.

(c) The alleged differences in the marine regulations of the two countries with respect to signal lights, and the advisability of adopting uniform signals for both countries.

(d) The advisability of building controlling works at the outlet of Lake Erie, including the effect upon the levels of the lakes and upon their shores, and upon the River St. Lawrence.

(e) The diversion southward by the Minnesota Canal and Power Company, of Duluth, of certain waters in the state of Minnesota that now flow north into the Rainy river and the Lake of the Woods.

(f) The effect of the Chicago Drainage canal upon the levels of Lake Michigan, Huron, Erie and Ontario, and upon the River St. Lawrence.

(g) Delimiting the international boundary on the international waterways and delineating the same on modern charts.

11. At subsequent meetings the following additional questions were brought to the attention of the commission, viz.:—

(h) The suppression or abatement of illegal fishing on the Great Lakes.

(i) The location and construction of common channels.

(j) Regulations to govern navigation in narrow channels.

(k) Protection of shores from damages due to deepening of channels and increased speed.

12. It was immediately evident that, in addition to collecting the data known to exist bearing upon these questions, it would be expedient for the commission to make its existence known to the persons most interested in the international waterways, to receive suggestions from them, and to visit in person some or all of the principal localities concerned, giving public hearings where such hearings were desired by the local business interests.

13. On July 7 the commission paid a visit of courtesy to the Canadian government, at Ottawa, and were the recipients of many graceful attentions from the authorities. Between July 9 and 13 the commission passed over the St. Lawrence river and canals from Quebec to Kingston, using the steamer *Frontenac*, kindly placed at their disposal by the Canadian government. During August, a majority of its members visited the Detroit, St. Clair and St. Marys rivers, and the Sault Ste. Marie.

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Between September 11 and 14, the full commission made an inspection of the outlet of Lake Erie, including Buffalo harbour and Niagara river above the falls, and of the water-power development at Niagara falls. Public hearings were held at Montreal, July 11; at Kingston, July 13; at Niagara Falls, September 14; at Toronto, September 15; at Hamilton, Ontario, September 16; and at Buffalo, November 10.

14. The meetings of the full commission were held at Buffalo, October 27 and 28, and November 10 and 11. To enable all persons to appear before the commission or to address it, who desire to do so, public notice of all meetings is given as long in advance as possible, through the press of the principal cities of the Great Lakes and St. Lawrence system.

15. Of all the questions brought to the attention of the commission, those most pressing for consideration were the questions relating to the uses of water at the Sault Ste. Marie. The situation there, in brief, is this: The volume of water flowing out of Lake Superior is, at normal low water elevation 601, about 64,000 cubic feet per second. Lower stages and a lower discharge have sometimes occurred. On either side of the rapids is a navigation canal, constructed by the United States and Canadian governments respectively.

The traffic through these canals has reached enormous proportions, and is increasing. It is larger this year than ever before, and will greatly exceed 40,000,000 tons for the year. The quantity of water consumed in the operation of the canals during the eight months of navigation is about 1,200 cubic feet per second. The quantity required in the future will be greater. Not less than 4,000 cubic feet should be unconditionally reserved for canal uses, and in granting power privileges, the respective governments should not forfeit the right to increase the amount indefinitely. It may be remarked, in passing, that raft navigation over the rapids has so greatly diminished and it is now so small in amount that the quantities of water above mentioned will suffice to provide for it. This leaves about 60,000 cubic feet which may be temporarily used for power purposes.

16. On the Canadian side the Lake Superior Power Company has a power canal in operation which has a capacity of about 9,000, and is using about 7,000 cubic feet per second. This company has designed an additional canal, not yet constructed, which will have a capacity of about 23,000 cubic feet per second. On the American side the Michigan Lake Superior Power Company has in operation a power canal, which has a capacity of about 31,000, and is using about 8,500 cubic feet per second. This canal takes the water from the St. Marys river above the rapids, conducts it through the city of Sault Ste. Marie, Michigan, and empties it about a mile below the rapids. On the American side also the Chandler-Dunbar Company, owning a portion of the shore line adjoining the rapids, have in operation power works using about 1,400 cubic feet per second. This company is engaged in altering and improving its works in the bed of the stream, under revocable permits from the War Department.

Under permits thus far granted, the consumption of water will be increased to about 3,000 cubic feet per second, but in March, 1902, the company applied for a permit to build a dike downstream from the fourth pier, counting from the American side of the international bridge in a direction nearly parallel with the shore, to connect with a power-house extending out an equal distance into the stream. A rival company, the St. Marys Power Company, applied in March, 1903, for permission to construct a power canal by means of two parallel dikes extending downstream and a short distance upstream, from the third and fifth piers of the bridge, with corresponding power-house. Neither of these latter requests was granted, but they show what the intentions of the companies are, if they be permitted to carry them out. Evidently there is not water enough to carry out all of these schemes. An understanding must be reached by which there shall be an equitable division of the surplus water between the two sides of the boundary. The division between rival companies, fortunately for the commission, may be left to the courts of law.

17. The applications to the War Department of the United States from the American companies for further privileges and an application from the Lake Superior

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Power Company to the Canadian government for additional authority, led the commission, at its session of October 28, to pass the following resolution, of which copies were sent to the Secretary of War of the United States and the Minister of Public Works of Canada, viz. :—

‘Resolved, That in the opinion of the commission, no further rights or privileges should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior, by either the government of the United States or Canada, until all data and information are in the hands of the commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such rights or privileges be granted, they be subject to any regulations that may be adopted by both governments.’

18. The use of water for power purposes must be so regulated as not to affect injuriously the level of Lake Superior. On the one hand, the level must never be allowed to fall so low as to injure navigation ; and on the other hand, it must never be raised so high as to submerge the shores.

19. The Act of congress, approved June 13, 1902, authorized the Michigan Lake Superior Power Company to divert water from St. Mary’s river above the rapids, with certain conditions, among which is the following, viz.:—

‘And conditioned further, that said company shall establish, maintain, and operate suitable and sufficient remedial and controlling works in the rapids of said river, to the approval of the Secretary of War and the Chief of Engineers ; and said company shall maintain and operate said canal and works in accordance with any rules and regulations that may hereafter be recommended by any international commission and that shall become operative.’

A full copy of the proviso will be found at page 8. In this legislation the principles were recognized that the use of the water was not granted in any fixed quantity nor for any fixed length of time, but that the Secretary of War could enter upon the property and close the canal in whole or in part at any time to the extent necessary to maintain water levels ; also, that it should finally be regulated by an international commission.

In granting permission to the company under this Act to divert water, the Secretary of War established, December 2, 1902, certain regulations (copy appended, marked ‘T,’ page 28), which are still in force and which will probably be used by this commission as a foundation in framing the regulations to be recommended. The fundamental principles on which they are based, and which this commission believes to be sound, are. (1) levels must be maintained ; (2) navigation must be protected ; (3) the public must reserve the right to use any portion or all of the natural flow in the future.

20. A public hearing at which the parties in interest were given an opportunity to be heard, was held in Buffalo, November 10, and at its session of November 11, 1905, the commission tentatively adopted certain rules and regulations, which it is hoped can be forwarded for approval at an early day.

21. The enforcement of these rules and regulations calls for the executive action from time to time of an international commission. The enforcement of rules to be established hereafter at other places or upon other subjects will probably likewise require joint executive action. It is not clear from the language of the law creating this commission that congress intended to provide for a permanent international board. It is desirable that the status of the present commission as a permanent executive board be defined or a new board be created.

22. The questions which have been brought to the attention of this commission, enumerated above in paragraphs 10 and 11, cover a wide range of subjects. Some of them clearly come under the jurisdiction of the commission as constituted, while some do not, and about others there is room for doubt. The Canadian members of the commission are ready and anxious to consider all of these questions and to extend the jurisdiction of the commission to all international waters between the Atlantic and

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Pacific oceans. It is desirable that the wishes of congress in this matter be more clearly defined.

23. Since it completed its organization in September, the commission has made good progress in the collection of data bearing upon some of these questions, particularly those relating to the use of water at Niagara Falls, and to the regulation of the level of Lake Erie by works near its outlet. With reference to the former, although not ready to report, it thought proper to pass, at its session of October 28, the following resolution, of which copies were sent to the Secretary of War of the United States, and the Minister of Public Works of Canada, viz. :—

‘Resolved, That this commission recommends to the governments of the United States and Canada that such steps as they may regard as necessary be taken to prevent any corporate rights or franchises being granted or renewed by either Federal, State or Provincial authority for the use of the waters of the Niagara river for power or other purposes, until this commission is able to collect the information necessary to enable it to report fully upon the ‘conditions and uses’ of those waters to the respective governments of the United States and Canada.’

24. To enable it to continue its investigations, an additional appropriation will be required.

Very respectfully,

(Signed) O. H. ERNST, *Chairman, American Section.*

(Signed) GEORGE CLINTON,

(Signed) GEORGE Y. WISNER, *Members, American Section.*

HON. WM. H. TAFT, Secretary of War, Washington, D.C.

SECOND INTERIM REPORT OF THE CANADIAN SECTION OF THE INTERNATIONAL WATERWAYS COMMISSION.

OTTAWA, ONTARIO, April 25, 1906.

Honourable C. S. HYMAN,
Minister of Public Works,
Ottawa, Ont.

SIR,—The Canadian members of the International Waterways Commission have the honour to submit the following report:—

At the last joint meeting of the International Waterways Commission, held in Toronto, on March 6 and 7, 1906, the chairman of the American section presented the following letter:

DEPARTMENT OF STATE,
WASHINGTON, February 13, 1906.

The Honourable Secretary of War,

SIR,—Several months ago the State Department and the British Ambassador took up the subject of a possible treaty between the United States and Great Britain relating to the use of the waters of the Niagara river and the preservation of the falls.

On November 13, the ambassador transmitted to the department a report of the Canadian Privy Council approved November 2, 1905, to the effect that a report from the Canadian section of the Waterways Commission stated that the commission was studying the subject, and expected to be able to make a joint report to the government of the United States and to the government of Canada before long, recommending the adoption of rules and regulations which would prevent, in the future, the destruction of Niagara falls by the use of its waters by manufacturers.

In the report of the American section, made to the Secretary of War on December 1, 1905, occurs the following statement: 'The commission have made good progress in the collection of data bearing upon some of these questions, particularly those relating to the use of water at Niagara falls.'

On October 20, 1905, the commission appears to have adopted the following resolution:

'Resolved, that this commission recommends to the governments of the United States and Canada that such steps as they may regard as necessary to be taken to prevent any corporate rights or franchises being granted or renewed by either federal, state or provincial authority, for the use of the waters of the Niagara river, for power or other purposes, until this commission is able to collect the information necessary to enable it to report fully upon the "conditions and uses" of those waters to the respective governments of the United States and Canada.'

The negotiation relating to a treaty on this subject has been suspended awaiting the further report of the commission, in accordance with the statements to which I have referred. There are many indications of active public interest in this subject, and a joint resolution having in view the preservation of the falls, pending in the House of Representatives, has been favourably reported by the Committee on Rivers and Harbours. The indications are that if an agreement can presently be reached between the two countries as to the action necessary to accomplish the purpose, any legislation to give the agreement effect on the part of the American authorities would

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receive favourable consideration at the present session of Congress and at the present session of the New York legislature.

It seems desirable, therefore to press forward the negotiations for such an agreement without any avoidable delay. May I ask you to make such a report upon the subject as may furnish a basis upon which the State Department and the ambassador may take and proceed with the negotiation?

I have the honour to be, sir,

Your obedient servant,

ELIHU ROOT.

The American section then urged that the question of the preservation of Niagara falls be taken up, before all other subjects, as being more immediately pressing.

The commission spent two days considering the details of a report upon the conditions at Niagara falls. When the commission had partly agreed upon the facts, a series of recommendations was suggested by the American section, to the effect that a treaty be concluded between the two countries, wherein it should be agreed to preserve for all time the scenic beauty of Niagara, by pledging each country to cancel all charters, other than those under which works had been actually constructed, and by agreeing to prohibit all other diversion of water which is naturally tributary to Niagara falls, except such as may be required for domestic use and for the service of locks in navigation canals.

The Canadian section opposed any hasty action, and an adjournment was made until April 26, at Washington.

Intimation was given at the meeting that unless the Joint Commission was prepared to report promptly, the American section might be called upon to give an independent report, in compliance with the following resolution which had been submitted to Congress:

‘Resolved, by the Senate and House of Representatives of the United States of America, in Congress assembled, that the members representing the United States upon the International Commission, created by section four of the River and Harbour Act, of June 13, 1902, be requested to report to Congress at an early date what action is, in their judgment, necessary and desirable, to prevent the further depletion of water flowing over Niagara falls; and the said members are also requested and directed to exert, in conjunction with the members of the said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of the said Niagara falls in their natural condition,’ and that in that case, it was likely that action would be taken looking to the negotiation of a treaty without further reference to our Joint Commission, and on March 19, the American section made a report to the Secretary of War, which has been transmitted to Congress by the President of the United States, by message, dated March 27 (copy of which is hereby appended, marked ‘A’).

In order that you may understand the situation, we desire to give you a short summary of the facts and conditions, as they now present themselves to us:

The volume of water discharged at Niagara falls varies from 180,000 cubic feet per second at low stage of Lake Erie, to 280,000 cubic feet per second at high stage of the lake, the mean discharge being 222,400 cubic feet per second at mean level of Lake Erie (elevation 572·86).

There are now five companies engaged in furnishing, or preparing to furnish, electricity, two located on the American side and three on the Canadian side of the river, above the falls.

The American companies, when in full operation, will develop about 340,000 horse-power, and use about 26,400 cubic feet of water per second, while the companies on the Canadian side, will have a capacity in all, of about 415,000 horse-power, and use about 32,100 cubic feet of water per second; the result being that from 27 to 33 per

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cent of the total volume of water which would otherwise go over the falls will be used for power purposes.

It is conceded by the American section that as the diversions of water on the Canadian side are made at or below the crest of the rapids, they do not affect, in any degree, the flow over the American fall.

The opinion of experts is that when these works are in full operation, while there will be a noticeable diminution of the water flowing over the falls, it will not have the effect of destroying or seriously impairing the scenic beauty of the falls; indeed, our own engineer is of the opinion that while the limit of development has been reached, even exceeded on the American side, a considerably larger use could be made for power development on the Canadian side, without injury to the falls. With this latter contention, the American engineer does not now agree. Both, however, are of the opinion that this latter question can be much more definitely and properly settled when the consequence of the present developments has become apparent.

Both the companies whose works are on the American side of the river, viz.: The Niagara Falls Hydraulic Power and Manufacturing Company, and the Niagara Falls Power Company, will distribute all their power in the United States. Two of the companies on the Canadian side, viz.: The Canadian Niagara Power Company, and the Ontario Power Company, intend using a large part of their power on the American side. In fact, the former has laid a wire on the traffic bridge, immediately below the falls, and intends laying wires across the river between Fort Erie and the city of Buffalo. The latter company has laid wires across the river at a point above Lewiston, known as the Devil's hole. Neither of these two companies has made any serious effort to distribute its power in Canada. The third company, the Electrical Development Company, are erecting transmission lines as far as Toronto, and intimate their intention to build other lines to supply the western section of the province as far as London.

The Cataract Power Company, who take their water from the Welland canal and use the escarpment at DeCew's falls, is the only other company operating in the same section; they are at present developing about 14,000 horse power, and use 600 cubic feet per second. This company, together with the Electrical Development Company, can supply all the immediate Canadian demand.

The only condition in the agreement between the Park Commissioners and the three companies operating on the Canadian side at the falls, relating to exportation of power, is as follows:—

'(II.) The company, whenever required, shall, from the electricity or pneumatic power generated under this agreement, supply the same in Canada (to the extent of any quantity not less than one-half the quantity generated), at prices not to exceed the prices charged to cities, towns and consumers in the United States, at similar distances from the Falls of Niagara, for equal amounts of power and for similar uses, and shall whenever required by the Lieutenant Governor in Council, make a return of prices charged for such electricity or power, and if any question or dispute arises involving the non-supply or prices of electricity or power for consumption in Canada, the High Court of Justice of Ontario shall have jurisdiction to hear and determine the same and enforce the facilities to be given or the prices to be charged.'

It will be seen that this provision, possibly, does not afford much protection; the companies themselves will not be inclined to build transmission lines in Canada while they have a much better market across the river, and no one on this side is at present in a position to demand power. The provision, in our opinion, creates, however, a moral obligation which your government should put itself in a position to enforce. At present, necessarily, if these companies are to be made to pay dividends they must sell their power where there is a market for it; so that to entirely refuse to allow them to export would be ruinous to them and not justified by the existing conditions. The Park Commission will receive a revenue of about \$250,000 a year from the three com-

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panies operating under agreements with them. This sum represents a very small proportion indeed of the yearly value of their franchises. It is estimated that the saving in cost of power at the point of production in favour of falling water over any other method is at least \$25 per h. p. This benefit should be apportioned in a reasonable degree between the producing companies and the general public. It will be a misfortune if the companies holding Canadian charters are not restricted in their exportation by regulations distinctly understood and accepted, which will compel them to carry out the spirit of their agreements by distributing power in Canada as demand is created, at reasonable prices. In the opinion of this commission adequate returns for their investment can thus be secured to the companies, while at the same time the Canadian public will obtain great advantage from the use of their natural advantage.

If there was a market in our country for one-half the power that could be generated at Niagara, its value put into millions per annum would be startling, but there is no such immediate demand and it seems to your commission that the present purpose of all concerned will be best served by preserving Niagara falls and at the same time making such provisions as are necessary to insure to our people the benefit of all the cheap power required. If we keep ourselves in a position to control the distribution of the power generated on the Canadian side of the river it will enable us to supply the requirements of our people for years to come without any further development.

The Dominion Parliament has granted charters to three corporations which are still in force, viz.: The Niagara Welland Power Company and the Jordan Light, Heat and Power Company, organized for the purpose of diverting water from the Welland river, which water would be taken from the Niagara river by back flow, and the Erie and Ontario Power Company, which would take its water from the Grand river and Lake Erie. These companies seem to be unlimited as regards the quantity of water that they may use or the power they may generate.

Quite irrespective of the question of injury to Niagara Falls the charter granted to the Erie and Ontario Power Company is subject to the further serious objection that its operation would have the effect of lowering the level of the water in Lake Erie.

As we already have at Niagara and DeCew's falls a development three times the Canadian demand it would seem to be the sheerest folly to increase the development until our own market requires it. It is very little advantage indeed to this country to develop power which is to be transmitted to the United States. We are, therefore, of opinion that it would be wise to enter into an arrangement with the United States, limiting the amount of water to be used on the Canadian side at Niagara river and elsewhere on the Niagara peninsula to 36,000 cubic feet per second. This will permit of the completion of the works now in operation on the Niagara river to their fullest capacity. It will also permit the Cataract Power Company to continue its operations and will give us a few thousand cubic feet per second for additional developments.

At Chicago, the Americans have built a drainage canal which, when in full operation, will use about 10,000 cubic feet of water per second.

The quantity of water required for the purposes of a ship canal is comparatively small, but the character of this drainage canal at Chicago is such as to involve a continuous flow of water which will have the effect of lowering Lake Michigan by over six inches, and Lake Erie by four and one-half inches. The nature of this work may be judged when we state that the expenditure will be some forty million of dollars, and that power works are in course of construction on the canal which will generate some 30,000 h. p.

As the diversion from Lake Michigan to the Mississippi river is of a much more serious character than the temporary diversions from the Niagara river, it is felt that the amount of water to be taken on the American side of the Niagara river should be limited to 18,500 cubic feet per second.

But, in the opinion of your commission, the preservation of Niagara falls is a minor matter as compared with the preservation of the interests of navigation on the Great Lakes.

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Lake Erie, as you know, is a shallow lake and the navigation interests already represented by capital investments of one thousand million of dollars are very much alarmed and are very insistent that the interests of navigation should be paramount and that there should be no further diversion whatever for power purposes which will interfere in any way with the mean level of the lakes. On the other hand, the demand for the use of power is growing every day and the time has come when it is absolutely essential that some dominant hand should intervene as between these conflicting interests and settle how and when, if at all, diversion is to be allowed of these boundary waters for power purposes.

It is exceedingly important in the interests of navigation, both to ourselves and the people of the United States, that the diversion by way of the Chicago drainage canal should be limited. It is equally essential in the interests of both countries that no diversion or interference should be allowed in streams crossing the boundary which would interfere with the interests of navigation in either country. It is all important that while we are settling the policy as to Niagara falls we should at the same time establish certain principles which shall be applied in settlement of all classes of dispute which can arise between the two countries with regard to the use of boundary waters or of streams which cross the boundary from one country to the other.

If our proposal is carried out the diversions will be about as follows:—

DIVERSIONS ON THE AMERICAN SIDE.

	Per Second. Cubic Feet
Niagara falls.. . . .	18,500
Chicago drainage canal.. . . .	10,000
	<hr/>
Total.. . . .	28,500

DIVERSIONS ON THE CANADIAN SIDE.

	Per Second. Cubic Feet
Niagara falls and on the Niagara peninsula.. . . .	36,000

It is quite apparent that no further diversions can be made on the Niagara river without injury to the scenic effect of the falls as a whole, and there should be no further diversion from Lake Erie or any other of the waters of the Great Lakes system which will be injurious to navigation. Your commission is, therefore, of opinion that the time has come when it is desirable to make a treaty limiting these diversions, and we have prepared a series of resolutions which we intend to submit at the next meeting of the joint commission, as follows:

Whereas, in the opinion of this commission it is desirable that the whole question of the uses and diversions of the waters adjacent to the boundary line between the United States and Canada, and the uses and diversions of all streams which cross the international boundary between the said countries should be settled by treaty,

Therefore, this commission recommend that a treaty be had between the United States and Great Britain, in framing which it should be recognized, that:

1. In all navigable waters the use for navigation purposes is of primary and paramount right, and therefore diversions should not be permitted which interfere with such use.
2. The Great Lakes system, on the boundary between the United States and Canada, and finding its outlet by the St. Lawrence to the sea, should be maintained in its integrity, and no diversions of water tributary to such streams should be permitted by either country, except as hereinafter provided.
3. Permanent or complete diversions of such waters are wrong in principle and should hereafter be absolutely prohibited. The diversions by the Chicago drainage canal should be limited to the use of not more than 10,000 cubic feet per second.

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4. Diversions of international waters elsewhere than at Niagara river or the Niagara peninsula should only be permitted,

(a) For domestic purposes and for the service of locks in navigation canals.

(b) Temporary diversions, where the water taken is returned again, only on the recommendation of a joint commission; such diversions not to interfere in any way with the interests of navigation and to be allotted in equal proportions to each country and so that each may have a like benefit.

5. It should be declared to be a principle with relation to the use of all navigable rivers and streams crossing the international boundary that no obstruction or diversion should be permitted, either on such rivers or their tributary streams, which will interfere with navigation in either country.

6. As to the diversions from Niagara river and on the Niagara peninsula:

(a) In the opinion of this commission it would be a sacrilege to destroy the scenic effect of Niagara falls unless and until the public needs are so imperative as to compel and justify the sacrifice.

(b) It is possible to preserve its beauty and yet permit the development on the Canadian side of the Niagara river itself and elsewhere by diversions on the Niagara peninsula to Lake Ontario of water for power purposes to the extent of not more than 36,000 cubic feet per second, exclusive of water required for domestic uses, and for the service of locks in navigation canals.

(c) It is likewise possible to allow the diversion of waters for power purposes on the American side to the extent of 18,500 cubic feet per second, exclusive of the amount required for domestic uses, and for locks in navigation canals, without serious injury to the scenic aspect of the falls.

(d) Your commission are of opinion, therefore, that for the present the diversions should be limited to the quantities mentioned in subsections *b* and *c*.

(e) This would give an apparent advantage to Canadian interests, but, as the diversion is not of serious injury to the falls and does not materially affect the interests of navigation, it is more than counterbalanced by the complete diversion of 10,000 cubic feet by way of the Chicago drainage canal to the Mississippi river.

7. Magnificent as are the scenic effects of the falls of Niagara, the commercial value of the power which its waters can produce is so very great, and the future need may be so pressing, that, in the opinion of your commission, it will be sufficient that a treaty with regard to the diversions there should be limited to the period of twenty-five or thirty years.

8. As to non-navigable streams flowing in either direction across the international boundary line, diversion for irrigation or other than 'innocent' uses, be allowed so that each country shall have an equal benefit from such diversions and that a joint commission shall have power to deal with and regulate such uses.

Suggestions have been made that the mean level of Lake Erie can be raised by the erection of a dam at the mouth of the Niagara river, but to this course strong objection is made by the parties in interest at Montreal and elsewhere who apprehend that the result would be to lower the level of Lake Ontario and the St. Lawrence river. It is admitted on all sides that if such will be the effect the work cannot go on. Your commission in due course will be able to report upon this important question.

Respectfully submitted,

(Signed) GEO. C. GIBBONS,
Chairman Can. Section.

(Signed) LOUIS COSTE,

(Signed) W. F. KING,
Members Can. Section.

(Signed) THOS. COTE,
Secretary Can. Section.

JOINT REPORT OF THE COMMISSION ON THE CONDITIONS EX-
ISTING AT NIAGARA FALLS, WITH RECOMMENDATIONS.

BUFFALO, N.Y., May 3, 1906.

The Honourable, the Minister of Public Works of Canada, and the Honourable, the Secretary of War of the United States:

The International Waterways Commission has the honour to submit the following report upon the preservation of Niagara Falls:—

The commission has made a thorough investigation of the conditions existing at Niagara falls, and the two sections have presented reports to their respective governments setting forth these conditions, to which attention is invited. The following views and recommendations are based upon a careful study of the facts and conditions set forth in these reports:

1. In the opinion of the commission, it would be a sacrilege to destroy the scenic effect of Niagara falls.

2. While the commission are not fully agreed as to the effect of diversions of water from Niagara falls, all are of the opinion that more than 36,000 cubic feet per second on the Canadian side of the Niagara river or on the Niagara peninsula, and 18,500 cubic feet per second on the American side of the Niagara river, including diversions for power purposes on the Erie canal, cannot be diverted without injury to Niagara falls as a whole.

3. The commission, therefore, recommend that such diversions, exclusive of water required for domestic use or the service of locks in navigation canals, be limited on the Canadian side to 36,000 cubic feet per second, and on the United States side to 18,500 cubic feet per second (and in addition thereto, a diversion for sanitary purposes not to exceed 10,000 cubic feet per second, be authorized for the Chicago Drainage canal), and that a treaty or legislation be had limiting these diversions to the quantities mentioned.

The effect of the diversion of water by the Chicago Drainage canal upon the general navigation interests of the Great Lakes system will be considered in a separate report.

The Canadian section, while assenting to the above conclusions, did so upon the understanding that in connection therewith should be expressed their view that any treaty or arrangement as to the preservation of Niagara falls should be limited to the term of twenty-five years and should also establish the principles applicable to all diversions or uses of waters adjacent to the international boundary, and of all streams which flow across the boundary.

The following principles are suggested:

1. In all navigable waters the use for navigation purposes is of primary and paramount right. The Great Lakes system on the boundary between the United States and Canada and finding its outlet by the St. Lawrence to the sea should be maintained in its integrity.

2. Permanent or complete diversions of navigable waters or their tributary streams, should only be permitted for domestic purposes and for the use of locks in navigation canals.

3. Diversions can be permitted of a temporary character, where the water is taken and returned back, when such diversions do not interfere in any way with the

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interests of navigation. In such cases each country is to have a right to diversion in equal quantities.

4. No obstruction or diversion shall be permitted in or upon any navigable water crossing the boundary or in or from streams tributary thereto, which would injuriously affect navigation in either country.

5. Each country shall have the right of diversion for irrigation or extraordinary purposes in equal quantities of the waters of non-navigable streams crossing the international boundary.

6. A permanent joint commission can deal much more satisfactorily with the settlement of all disputes arising as to the application of these principles, and should be appointed.

The American members are of opinion that the enunciation of principles to govern the making of a general treaty is not within the scope of their functions; moreover the jurisdiction of the American members is restricted to the Great Lakes system.

GEO. C. GIBBONS,
Chairman, Canadian Section.

O. H. ERNST,
Colonel Corps of Engineers, U.S.A.,
Chairman, American Section.

W. F. KING,
Commissioner.

GEORGE CLINTON,
Commissioner.

LOUIS COSTE,
Commissioner.

GEO. C. WISNER,
Commissioner.

THOS. COTE,
Secretary, Canadian Section.

L. C. SABIN,
Secretary, American Section.

REPORT ON THE CONDITIONS EXISTING AT SAULT STE. MARIE,
WITH RULES FOR THE CONTROL OF THE SAME, RECOM-
MENDED BY THE INTERNATIONAL WATERWAYS
COMMISSION.

BUFFALO, N.Y., May 3, 1906.

The Honourable, the Minister of Public Works of Canada, and the Honourable, the Secretary of War of the United States:

The International Waterways Commission has the honour to submit the following report upon the conditions existing at Sault Ste. Marie, with rules for the control of the same.

Upon the organization of the International Waterways Commission, it found the most pressing matter coming within its jurisdiction was the regulation of the use by private corporations of the waters of St. Marys river in connection with the control of those waters for the protection of navigation at present, and in the future. The commission, therefore, proceeded to an investigation of the local conditions by special committee and the study of all data obtainable. After thorough consideration of all the information which could be obtained, and after hearing all parties interested in the use of the waters at Sault Ste. Marie, including navigation interests, the commission is satisfied that the rules recommended herein, governing the use, or interference with the natural flow, of those waters, will do entire justice to private interests, and, at the same time, fully protect commerce and navigation.

The extent of the commerce on the Great Lakes is well illustrated by the official statistics of the amount of freight which passed the locks at Sault Ste. Marie during the season of navigation in 1905, which amounted to more than forty-four million net tons. To this should be added the local tonnage, which is considerable, and the large traffic between ports on Lakes Michigan and Huron and the east, making a total lake traffic of between fifty and sixty million tons. The immense importance of transportation by the Great Lakes, and the consequent necessity of protecting and facilitating it in the interest of the public, becomes apparent when we consider that the ability to transport by lake must have resulted, during the season of 1905, in saving many millions of dollars. The average rate for transportation of Lake Superior freights in 1905 was \$·00085 per ton-mile, while from the best information obtainable the transportation rate by rail between Lake Superior point and the east is not less than \$·004 per ton-mile. The ton-mile saving over railroad transportation was, therefore, at least \$·00315. The average haul of the freight mentioned was eight hundred thirty-three and three-tenths miles. The total number of tons of freight that passed the Sault locks in 1905 was 44,270,680, and it follows that in this year there was an aggregate saving through lake transportation on Lake Superior, through freight alone, of approximately \$116,000,000. In other words, by transporting the Lake Superior freight on the Great Lakes, \$116,000,000 were saved, in 1905, to the producers of raw materials, the manufacturer and the consumer, and the saving to manufacturers has made it possible for them to supply the home markets and compete in those of foreign countries.

The growth of commerce upon the Great Lakes in the past few years, and its prospective immense increase in the future, has convinced the commission that steps should be taken, not merely to preserve the lake levels, but to retain absolute control of all waters which go to maintain those levels, and of all lands which may be useful

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or necessary, at present or in the future, to increase navigation facilities. The commission is, therefore, decidedly of the opinion that the governments of the United States and Canada should act in unison in controlling, absolutely, any and all diversions at Sault Ste. Marie, so that the waters of the river may be available at any time when needed for navigation.

ST. MARY'S RIVER.

Our investigation of conditions at Sault Ste. Marie developed the following facts:

The St. Mary's river forms the connecting channel between Lake Superior and Lake Huron. In its length of sixty-four miles the total fall has varied, in recent years, from 21 to 23 feet; of this total fall, from 18 to 20 feet is found in a distance of three-fourths of a mile at the Rapids at Sault Ste. Marie. The entire run-off of the Lake Superior drainage basin, having an area of 76,100 square miles, passes the St. Mary's river, giving an average discharge of about 70,000 cubic feet of water per second. As this river forms the only means of water communication between the important industries of the Lake Superior regions and the eastern markets, the advisability of its improvement for navigation purposes was early recognized. In 1855 the first canal and lock capable of passing lake vessels was completed, at a cost of about one million dollars. There were two tandem locks, each seventy feet wide, three hundred and fifty feet long, having a lift of about nine feet each, with a depth of eleven and one-half feet of water on the mitre sills. The great increase in the number and size of boats passing through the St. Mary's river necessitated the construction, in 1870, of the Weitzel lock. This lock, completed in 1881, and still in service, is five hundred and fifteen feet long, eighty feet wide in the chamber, and has about fourteen feet of water over the mitre sills at ordinary low water level.

The increase of lockage facilities did not accommodate the rapid increase in the size and number of vessels necessitated by the constant and great increase of the commerce which passed through the river, and as a result it became necessary to construct another lock on the American side. Accordingly what is known as the Poe lock, was built. It has a chamber eight hundred feet long, one hundred feet wide and a depth of about nineteen feet at ordinary low water.

It was supposed the Poe lock would accommodate the commerce of Lake Superior for many years. But it, together with the Weitzel lock and the Canadian lock, hereinafter described, has at times proved inadequate for proper despatch of the lake vessels passing the rapids, and it is quite evident that in the near future further lockage facilities must be furnished to meet the demands of commerce.

On the Canadian side of the river a lock nine hundred feet long, sixty feet wide, and having about nineteen feet of water on the mitre sills at ordinary low water, has been constructed. It was completed before the Poe lock. There are several vessels now navigating the lakes, which this lock cannot accommodate, their beam being 60 feet or more.

The improvement of the St. Mary's river below the locks has been almost continuous, and consists of the clearing of channels, and the construction of the so-called 'Hay Lake Channel.' An available depth of from 17½ to 19 feet, depending on the stage of water, has been obtained. At present the United States government is engaged in deepening the channels to a depth of 21 feet at low water, and in constructing a new channel through the West Neebish, which will furnish an additional passage connecting Hay lake with Mud lake. This channel will have a least width of 300 feet, and low water depth of 21 feet, or sufficient to accommodate all vessels now navigating the river. These improvements have cost the government of the United States about fourteen millions of dollars and the government of Canada about five millions.

The increase in the size of vessels navigating the lakes, has been rapid. In 1890, lake vessels reached a length of 300 feet, in 1896 400 feet, in 1902 500 feet, and six vessels 600 feet in length will be put in service during 1906. In 1904, there were only

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forty boats in the Lake Superior trade, with a capacity of 8,000 tons or more, while thirty-two additional vessels will be in commission during 1906, none of which will have a cargo capacity of less than 8,000 tons. The combined cargo capacity of these thirty-two new boats will be about 338,000 tons for a single trip, and they will constitute an addition of about twenty per cent to the carrying capacity of the fleet engaged in the transportation of ore from Lake Superior.

The quantity of freight passing to and from Lake Superior has doubled twice in the past thirteen years, it being 44,270,680 tons in 1905, about four times what it was in 1892. The value of the cargoes passing the Sault canals in 1905 was \$416,965,484; iron, including ore and manufactured iron, constituting twenty-seven per cent of this value, and cereals twenty-eight per cent.

It is estimated that the present lockage system is capable of giving what may be considered reasonably prompt service, if not required to pass more than fifty million tons during the season of navigation, but if called upon to pass more than sixty million tons, delays, which are not infrequent now, will become excessive, and cause great financial loss. In view of the past growth of this commerce, it is extremely hazardous to predict its extent in the future, but a conservative estimate indicates that before another lock can be completed the limit of traffic for prompt service will have been passed. In this connection we would call attention to the fact that the largest classes of boats existing, and now being rapidly built, are already restricted in carrying capacity on account of deficient available depth of water, and are subject to delays because not more than one of them can be passed through the largest lock at one time. In addition to this, many of the largest boats now navigating the lakes are limited to the use of the Poe, and the Canadian locks, on account of their size. The rate of increase in traffic and in the size of boats, in the future, judging from the experience of the past, and the predictions of those conversant with the subject, will make the present lockage system inadequate before lockage facilities can be increased. The loss, financially, which would result from not furnishing means of passage around the rapids adequate to the demands of commerce, or, in case of accident to any of the existing locks, from delay until repairs could be made, would be incalculable.

The canal leading to the American locks from the upper river is 4,200 feet in length, and has an average cross section of about 5,000 square feet. Its width at the narrowest part is only 108 feet, it being crossed at that place by the swing span of the International Bridge. The sides of this canal are frequently lined with vessels awaiting down passage when vessels are leaving the locks to pass into Lake Superior. The manœuvring of boats going in opposite directions in such a narrow passage is very difficult, and is accompanied by possibility of accident. The conditions are seriously aggravated by a strong current, which occurs in the canal whenever the locks are filled. Plans have been made by the United States government for enlarging this canal, doubling its width at the narrowest place, and increasing the width at other points. This would relieve the situation at present, but it is quite apparent that provision should be made for further widening, so that when a new lock shall have been constructed, two or more locks may be filled at the same time without creating a violent current. This will necessitate the acquisition of more land on the river side than is now owned by the United States.

The Canadian canal is about 6,000 feet long, from 143 to 156 feet wide, and something over 22 feet deep. The Canadian lock above mentioned is at the eastern extremity of this canal. The same general considerations apply to this canal and lock that we have presented in connection with the American canal and locks.

WATER POWER DEVELOPMENTS.

The development of the power of the St. Mary's rapids has been projected and carried on by practically two interests: the Chandler-Dunbar and allied interests, and the Lake Superior Corporation with its subordinate companies, the Lake Superior Power Company and the Michigan Lake Superior Power Company.

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In 1883 Wm. Chandler was granted letters patent for a strip of land about 3,000 feet in length, lying along the north side of the St. Mary's Falls canal, adjoining the rapids on the American side of the river. In 1887 the Edison Sault Light and Power Company was organized for the purpose of developing water power at this point, and the following year a canal, about 2,200 feet long, was dug through this property, the power developed being used locally, largely for electric lighting. In 1889 a permit was granted the above company by the government of the United States to extend its tail-race by connecting the lower end of the embankment with Islnad No. 3, and in 1893 a permit was given for joining Islands Nos. 3 and 4, which lay in front of the lands owned by the United States, thus providing for a trail-race to enable the company to utilize a somewhat greater head than the fall naturally existing in front of the lands located by Mr. Chandler.

In 1892 a permit was granted by the Secretary of War to the Edison Sault Electric Company, the lessee of the Chandler-Dunbar Company, to build an embankment dam from the third pier of the international bridge, extending down stream. The completion of this dam or dyke provided a more commodious head race, and the water power developed has been increased since that time, as local needs demanded.

In 1901 this permit was modified to provide for the building of a new power house in front of the lands located by Mr. Chandler, and the construction of a new tail-race outside of Island No. 3, belonging to the United States, on condition that the company should 'abandon the tail-race, now used on the inside of Island No. 3, and relinquish to the United States all rights of the company between said island and the shore.'

In 1903 this permit was again modified so as to allow the company 'to build out into the rapids of St. Mary's river,' to remove the power-house and a portion of the embankment dam now in use, and to construct a larger power-house and longer wall to inclose a forebay, and to construct a wider tail-race. Work under this last permit was commenced in the spring of 1905, and is now in progress.

The available head of water on the present works is about 9 feet. The power developed by the turbines is about 750 horse-power. The amount of water used in this development is about 1,400 cubic feet per second, including leakage. The natural fall in the rapids in front of the shore holdings of the company was found to be about 9 feet, when it was measured in the fall of 1903.

The building, in 1892, of the dyke above mentioned, under permit of that year, obstructed the flow through the rapids under two spans of the international bridge, shutting off a water area about 1,915 square feet in cross section.

Work is now progressing under the permits granted by the War Department of the United States, and it is expected that a head of about 13 feet will be obtained, furnishing 4,700 mechanical horse-power by the consumption of 4,000 second feet.

The interests constructing these works claim the right to do so, not only under the permits granted, but, so far as the occupation of the bed of the rapids opposite the Chandler lands is concerned, by virtue of asserted riparian rights appurtenant to the ownership of the adjacent shore. In a litigation now pending, brought by the United States against the Chandler-Dunbar Water-Power Company in the western district of Michigan, the District Court has decided that the ownership of the shore lands carries with it the title to the bed of the river, including Islands Nos. 1 and 2, and from this it follows that the right to erect structures in the river to utilize the waters of the river for power purposes as it flows past the riparian owners' land exists, subject merely to the restriction that the structures must not, directly or indirectly, injuriously affect navigation.

The Lake Superior Corporation, through its subordinate companies, the Lake Superior Power Company, organized under the laws of the province of Ontario, and the Michigan Lake Superior Power Company, organized under the laws of the state of Michigan, has constructed canals on both sides of the river, with works for the development of power.

On June 30, 1888, 'The Sault Ste. Marie Water, Gas and Light Company,' was

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incorporated on the Canadian side, under the Revised Statutes of Ontario, chapter 164. By Act of 1889, the name of the company was changed to 'The Ontario Water, Light and Power Company,' and it was given power to build dams across the inland channels or rapids of St. Mary's river or any branch thereof within the province of Ontario, and to construct such other works as might be necessary to supply them with the water needed for their operations, such rights to be exercised only with the consent of the Crown or the individual affected.

After partially completing a water-power canal, this company became financially embarrassed, and was not able to continue the undertaking.

In 1895, Francis H. Clergue and his associates took over the property of the old company, including franchises for supplying the town with electric lighting, water and street railway privileges. At the same time the name of the company was changed to 'The Lake Superior Power Company,' and in 1896 a portion of St. Mary's island opposite the rapids was granted to the company, in exchange for certain other lands in the town of Sault Ste. Marie, Ont. The Lake Superior Power Company also acquired other lands in the vicinity north of the Canadian ship canal, and at once began the development of water-power. 'The Consolidated Lake Superior Company' was formed in 1901 to consolidate and control the interests of this company, the Michigan Lake Superior Power Company, and many others, and in 1904, it was re-organized under the name of 'The Lake Superior Corporation.'

The canal of the Lake Superior Power Company is about 220 feet wide at the water line, and $12\frac{1}{2}$ feet deep at the head gates, changing gradually to a prism 86 feet wide and $15\frac{1}{2}$ feet deep at the power-house. The present plant is developing about 11,000 horse-power at the turbine shafts. The average amount of water used has been estimated at about 7,000 cubic feet per second, with a maximum of 8,000 cubic feet per second when all wheels are running at full capacity.

In building its works this company occupied the bed of a small stream, running between the islands on the north side of the river, having a water cross section estimated at 1,603 square feet. This company, with its allied company, the Michigan Lake Superior Power Company, to be described below, has also erected remedial works on the Canadian side of the river above the 9th and 10th spans of the international bridge, being the two spans nearest to the Canadian shore, making it possible to nearly stop the flow of water under those spans. The same company has projected a second canal of much larger capacity, work upon which has not been begun.

About 1887, the St. Mary's Falls Water Power Company began excavation for a canal through the town of Sault Ste. Marie, Michigan, from a point above the ship canal, to connect with the river below the locks. The company failed, and its right of way was purchased by the Michigan Lake Superior Power Company, incorporated under the laws of Michigan, one of the allied companies subsequently forming the Consolidated Lake Superior Company.

The Michigan Lake Superior Power Company has constructed a canal over two miles in length with a cross sectional area of about 4,300 square feet, extending from above the upper end of the St. Mary's Falls ship canal to a point about a mile below the locks, where it debouches into the lower river.

Pursuant to the provisions of the River and Harbour Act, approved June 13, 1902, the Secretary of War of the United States, under date of December 12, 1902, granted the Michigan Lake Superior Power Company a permit for the diversion of the waters of the St. Mary's river through its canal, subject to prescribed regulations, based upon the maintenance of proper water levels, including the erection of remedial works. The remedial works have been partially constructed, but owing to the fact that they have not been completed, and to the fact that repairs to the company's power-house and forebay are needed, the full capacity of the canal, 31,200 second-feet, is not used, 8,500 second-feet being the estimated amount actually utilized at present. The remedial works, so far as completed, are those above mentioned, partially covering the spans nine and ten of the international bridge on the Canadian side.

HYDRAULIC CONDITIONS.

The head of the canal at St. Mary's rapids is situated about fourteen miles below Point Iroquois, which may be considered the head of St. Mary's river. In this fourteen miles there is a fall of only about 0:4 foot. As this slope is so slight it is practically constant for all stages of water level, and the mean level of Lake Superior is directly affected by any changes in level that may occur in St. Mary's river above the rapids. The lowest monthly mean level of St. Mary's river above the locks, within the past thirty-three years, was in March, 1879, the level being 600:38 feet above mean tide at New York. Since that year it has never been below 601:0 feet during the months of the navigation season, May to November. Since 1893, there has been but one month during the navigation season when the mean level fell below 601:7 feet. Since 1876, the mean level has never been above 603:2 feet.

Previous to the building of the international bridge in 1887, the channel of St. Mary's river at the rapids consisted of the main channel and four small streams running between the islands near the Canadian side. At a water level of 601:7 feet, the cross sectional area of these streams previous to obstruction is estimated to have been about 13,452 square feet for the main channel, and 2,064 square feet for the small streams, giving a total area of section of 15,516 square feet. This cross section has been obstructed from time to time by the following works:—

In 1887 the international bridge was built across the rapids near the head. The piers in the rapids cut off an area of section of about 1,133 square feet. During the building of the bridge and subsequently, fills have been made near the ends of the bridge, causing a further obstruction estimated at about 1,139 square feet, including three of the small streams above mentioned, and making a total estimated area of section obstructed by the bridge of about 2,272 square feet.

The building, in 1889, of the canal subsequently purchased by the Lake Superior Power Company on the Canadian side, obstructed the fourth of the small streams mentioned above, estimated to have had an area of 1,603 square feet. Subsequently, this company, in connection with the Michigan Lake Superior Power Company, constructed remedial works across spans 9 and 10 of the bridge, span 10 being completely closed and span 9 being closed by stoney gates, which may be opened if necessary. The cross sectional area of span 10 so obstructed was about 724 square feet, and of span 9, 1,649 square feet, giving a total cross section of obstruction of 2,373 square feet for remedial works, or 3,976 square feet, if we include the small stream mentioned above.

The dyke built by the Chandler-Dunbar Water Power Company in 1892 closed the area under the first two spans of the bridge with a total water cross section of about 1,915 square feet.

The total area thus obstructed by all works amounts to 8,163 square feet, or more than one-half of the original cross section. The total area of cross section obstructed previous to the construction of the remedial works was 5,790 square feet.

The first effect of these various obstructions was to reduce the discharge of the river, although the flow through the channels not obstructed was somewhat increased. If no diversion were made, the discharge over the rapids being diminished, the mean water level would eventually rise to such a height as to give a discharge through the restricted cross section equal to that which would have taken place through the original cross section at the lower level. The elevation of the water surface would then fluctuate about this new higher mean level much the same as it did before about the lower mean level. The decrease in discharge, due to the obstructions mentioned above other than the remedial works, may be roughly estimated as follows for stage 601:7 feet:—

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	Sec. Ft.
Flow intercepted by international bridge piers and fills.. ..	7,000
Chandler-Dunbar Company.. .. .	7,500
Works of Lake Superior Power Company.. .. .	4,500
Total.. .. .	19,000

Since to determine the discharge of the river by observations from the international bridge, the section upon which most of the observations for discharge have been made, involves estimating the amount of water used by the locks and the several power companies, in order to arrive at the total discharge, the results of the discharge measurements are not always accordant. These observations for discharge have not extended over as wide a range of level as could be desired to give a good determination of the rate of change in discharge for change in stage. From a consideration of the published results, however, it appears that previous to the placing of the remedial works at spans 9 and 10 of the bridge, that portion of the discharge of the river passing the rapids alone was 66,500 second feet, at elevation 601·7 feet, and 80,400 second feet, at elevation 602·7 feet. If these discharges are correct, a rise in the water surface of one foot corresponds to an increase discharge of 13,900 second feet and the effect of placing obstructions cutting off 19,000 second feet would therefore be to eventually raise the mean lake level approximately 1·4 feet.

Only a portion, perhaps not more than half, of this obstruction, has actually been effective for the reason that it takes place slowly, and that the obstruction has not been complete since the channels have been replaced by the power canals, through which the water is allowed to pass.

As the result of observations of discharge made in 1899 and 1902 by the officers of the United States' Lake Survey, equations were determined representing the flow in the rapids, first: in spans 3 to 10, inclusive, or previous to the construction of the remedial works, above spans 9 and 10 on the Canadian side of the river, and second: in spans 3 to 8, inclusive, or after the remedial works were in place. From these equations, it appears that previous to the placing of the remedial works, the discharge at 601:7 feet was 66,485 cubic feet per second, and that with the remedial works in place, the discharge at this stage is 56,880 cubic feet per second, giving a diminished discharge, due to the placing of the remedial works of 9,605 cubic feet per second at this stage.

The total flow stopped by the obstructions placed by the various companies may then be summarized as follows for stage 601:7 feet :—

	Sec. Ft.
Bridge.. .. .	7,000
Chandler-Dunbar Water-Power Company.. .. .	7,500
Lake Superior and Michigan Lake Superior Company.. .. .	14,100
Total.. .. .	28,600

The present uses of water are estimated to be as follows:—

	Sec. Ft.
Government canals.. .. .	600
Chandler-Dunbar Water-Power Company.. .. .	1,400
Lake Superior and Michigan Lake Superior Power Company.. .. .	15,500
Total.. .. .	17,500

Previous to the placing of the remedial works of the Lake Superior Power Companies, above spans 9 and 10 of the international bridge, the discharge of the river at elevation 601:2 was probably about 61,000 second feet. Although the discharge may have fallen below this figure for a few months in years of low water, it may be taken as the ordinary low water discharge. Of this amount not less than 4,000 second feet

should be reserved for the use of locks and the passage of logs. The Michigan Lake Superior Power Company has a canal designed to take a maximum of 31,200 second feet, the Chandler-Dunbar Water-Power Company has works under construction designed to use 4,000 second feet, and contemplates still further development. The Lake Superior Power Company's present works are sufficient to use at least 9,000 second feet, and further development is contemplated, presumably to the extent of using one-half the surplus waters of the river.

It is apparent, therefore, that the actual present use of water for power purposes is nearly equal to the amount of flow obstructed by the works of all the power development companies considered as a unit, and it is clear that the amount of water required for the proposed additions to present power developments is so great as to call for complete control of such extensions by an international commission.

At present the duty of maintaining the water level above the rapids rests upon the Michigan Lake Superior Power Company; the Act of Congress approved June 13, 1902, authorizing this company to divert water from St. Mary's river, with the consent of the Secretary of War, and the Chief Engineer, specifically provides that the level of Lake Superior shall be maintained at the expense, if need be, of the works of this company. With the knowledge that plans for enlarging the works of the power companies were projected, Congress, in the same Act, provided for an investigation of the conditions with a view to an agreement looking to international control and regulation. The commission has used the rules and regulations under which the Michigan Lake Superior Power Company was permitted by the Secretary of War, of the United States, to divert the waters of the St. Mary's river, as a basis for the new rules now recommended, adapting them to the wider application now necessary.

RECOMMENDATIONS.

The commission would respectfully recommend :

1. That no permits shall be granted for the use of the waters of the St. Mary's river, or for the erection of structures in, under or over, or the occupation in any manner of the said waters until plans have been submitted to the commission for its investigation and recommendation; and the use of the waters under such permits shall not be allowed except upon compliance with the rules hereinafter recommended.

2. The commission further recommends that no grants, permits or concessions should be made, which directly or by operation of law, may, in any manner, affect the right of the United States or of Canada, to control the bed of the St. Mary's river, below high water mark, and especially that none should be made which, legally or equitably, may be the means of adding to the expense of acquiring lands or rights for the purpose of making improvements in aid of navigation, or which may give an equitable right to compensation in case of the removal of structures in said river.

3. That steps shall be taken to increase the lockage facilities at Sault Ste. Marie without unnecessary delay.

4. That the governments of the United States and Canada reserve all water necessary for navigation purposes, at present or in the future, and the surplus shall be divided equally between the two countries for power purposes.

5. As the commission regards the interests of the United States and Canada in the preservation of the lake levels, and in the improvement of the channels and the conservation of the water supply for purposes of navigation as identical and as incapable of efficient protection without joint and harmonious action on the part of the two governments, it recommends that the rules hereinafter set forth be adopted, and that a joint commission be created to supervise their enforcement, or that such powers be vested in the existing International Waterways Commission, subject to such restrictions and reservations as may be deemed advisable.

The commission has adopted unanimously the following resolution :—

Resolved, That this commission recommends to the Secretary of War of the United States, and the Minister of Public Works of Canada, the following rules to govern the use of water at the Sault Ste. Marie :

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1. No person shall place any structure in, over or under the St. Mary's river, nor shall any person place any obstruction in said river, or make any excavation in the bed thereof, or divert water therefrom, until plans for the work shall have been submitted to an International Waterways Commission nor until consent shall have been given by the Secretary of War of the United States, and the Minister of Public Works of Canada. All work must be done in accordance with plans approved by such commission, and subject to its supervision and inspection; and no water shall be used or diverted until the completed work shall have been approved by the commission.

2. Persons now using or diverting the waters of St. Mary's river for power purposes shall forthwith submit complete plans of all their works existing and proposed, and until such plans have been approved by the commission, they shall not use or divert the waters of said river in excess of the amount now actually used or diverted by them.

3. Plans for work contemplating the use or diversion of water, must include such remedial and controlling works as may be necessary to maintain levels. Such works must provide for (1), compensation equal to the amount of water to be used or diverted, (2), complete stoppage of flow through canals and works, (3), passage of the amount of water naturally flowing through the section occupied by the remedial works, (4), passage of logs over the rapids.

4. The level of St. Mary's river above the rapids, shall be maintained between the elevations 601.7 and 603.2 feet above mean tide at New York, according to the system of levels established by the United States government in 1903, and defined by a bench mark on the coping of the Weitzel lock at Sault Ste. Marie, Michigan, the elevation of which is 606.069. The approval of plans of works by the commission, and the consent of the Secretary of War and Minister of Public Works to construct works or to use or divert water, shall in no way relieve the owners and persons operating such works from the duty of maintaining said level.

5. Nothing herein contained shall be held to affect any existing riparian or other rights, or the existing remedies therefor, or any action at law or in equity now pending. All remedies herein provided shall be cumulative and shall be without prejudice to any other remedies for failure of persons operating under permits to maintain the levels for navigation purposes. Nothing herein contained shall be held to affect the exercise of the right of any executive officer of either the United States or Canada, acting under the laws of his respective country, to prevent the placing, or to cause the removal of any obstructions in St. Mary's river, or to otherwise preserve or restore the navigability of any part thereof.

6. Persons using or diverting the waters of St. Mary's river shall operate under the following regulations :—

(a) The general superintendent of St. Mary's Fall canal, under the orders of the engineer officer in charge on the American side, and a resident officer appointed by the Canadian government on the Canadian side, shall form a board whose duty it shall be to see that these regulations, and any others that may hereafter be made by proper authority, are duly obeyed. The officers of this board and their deputies shall have access to all the power works at any time, and all said power works, which terms includes canals, escape valves at the power houses, head gates and remedial works, shall be operated in accordance with the orders of the said board, and said board shall have power to assume entire control of said works, or any of them, whenever it considers such action necessary in the interests of navigation.

(b) Should the monthly mean level fall below 601.7 feet for any calendar month, the flow through the power works shall be reduced to such an extent as to restore the monthly mean level to 601.7. Should the monthly mean level remain below 601.7 feet for six consecutive months, all flow through the power works shall be stopped until the monthly mean level shall again be above 601.7 feet. Should the monthly mean level fall below 601.2 feet, all flow shall likewise be stopped until the monthly mean level shall again be above 601.2 feet.

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(c) Should the monthly mean level rise above 603·2 feet, the flow through the power canals and remedial works shall be increased to their maximum capacity, and shall so continue until the monthly mean level shall be less than 603:2 feet.

(d) Should the power canals, remedial or controlling works be found not to be of the capacity to produce the regulation required, the persons using the water shall alter their works at their own expense as soon as possible, so as to allow more to flow, in a manner approved by an international commision.

(e) Should currents detrimental to navigation be developed by the operation of any power works, the persons operating such works shall alter them or construct such other works as an international commission may consider necessary to remedy the evil, all in a manner to be approved by said commission.

(f) The board mentioned in regulation (a), shall have power to determine whether the conditions mentioned in any of these regulations have arisen to call for the application of said regulations, and its determination shall be final; and said board shall have power to apply to any power works such special regulations as they may deem necessary in the interests of navigation.

(g) If remedial works can be used for the passage of logs or rafts, the gates must be operated at the expense of the persons owning or operating the works whenever needed.

7. Wherever powers of officers are mentioned in these rules, it is understood that the governments of the United States and Canada reserve the right to vest such powers in, and confer others upon, other officers or the international commission.

8. It is further understood that the governments of the United States and Canada reserve the right to amend, add to, or abolish these rules or any of them by joint action and that they may vest the power so to do in the international commission.

9. In the event of any person subject to these regulations refusing or neglecting to obey, abide by, or conform to any ruling, direction or order of the commission, or of the board mentioned in regulatin (a), such commission or board may, through their officers, servants, or agents, at once shut off the supply of water to such person, or to take such steps to compel compliance with such ruling, direction or order as the commission or said board may deem proper.

10. Persons owning or operating power canals or works shall not be entitled to damage or compensation from the government of the United States or Canada in any case whatsoever, for any act or acts done by them or either of them, or by their officers or agents at any time, in executing or enforcing these rules, or in exercising the right to control or suspend the flow of water through canals or remedial works, or both, or in revoking or annulling any permits of grants which may have been or shall hereafter be issued or made to such persons.

11. For the purpose of construing these rules, the word 'person' or 'persons,' shall be taken as including natural persons, corporations, associations and partnerships, whenever they are used, but shall not include the government of the United States or that of Canada.

(Sgd.) GEORGE C. GIBBONS,
Chairman, Can. Sec.

(Sgd.) O. H. ERNST,
Chairman, Amer. Sec.

(Sgd.) W. F. KING,
Commissioner.

(Sgd.) GEORGE CLINTON,
Commissioner.

(Sgd.) LOUIS COSTE,
Commissioner.

(Sgd.) GEO. Y. WISNER,
Commissioner.

(Sgd.) THOMAS COTE,
Secretary, Can. Sec.

(Sgd.) L. C. SABIN,
Secretary, Amer. Sec.

JOINT REPORT ON THE APPLICATION OF THE INTERNATIONAL DEVELOPMENT COMPANY FOR PERMISSION TO CONSTRUCT REGULATING WORKS ON THE RICHELIEU RIVER.

BUFFALO, N.Y., November 15, 1906.

To the Honourable the Minister of Public Works of Canada, and to the Honourable the Secretary of War of the United States.

The International Waterways Commission has the honour to submit the following report on the application of the International Development Company for permission to construct regulating works in the Richelieu river, referred to it by endorsement of the Honourable Secretary of War of the United States, dated November 6, 1906.

The applicants are the assignees of a charter granted by Special Act of Parliament of the Dominion of Canada to the Lake Champlain and St. Lawrence Ship Canal Company (Statutes of Canada, 1898, chapter 107), which has been extended by two enactments, the last of which, in the year 1905 (Statutes of Canada, chapter 116), extends the time for commencing the works of the company to the year 1908.

No plans of the proposed works have been submitted, and it is understood that none have been made. The works are to be located in Canadian territory, and can be built only with the authority and approval of the Canadian government. It is supposed that proper plans will in due season be submitted to that government. The works will, however, affect the levels of Lake Champlain, and may thus seriously affect the navigation or property interests of American citizens on that lake. The company submits a preliminary statement showing in general what is proposed to be accomplished, and the supposed effect upon Lake Champlain, with a view to ascertain what the attitude of the United States government will be towards the enterprise, and it is that which has been referred to us.

It is ascertained from this statement that for navigation and power purposes a continuous flow of not less than 9,000 cubic feet per second is desired in the Richelieu river. The average annual flow is greater than this, being about 12,700 cubic feet per second. The low water discharge is about 3,800 cubic feet per second, and there are periods, sometimes extending over six or eight months, when the discharge is continuously less than 9,000. It is proposed to store up in Lake Champlain during the high water season enough of the surplus water to supply the deficiency during the low water season. For this purpose regulating works are to be constructed in the Richelieu river by which the level of Lake Champlain will be maintained at a minimum of 97 feet above tide at New York; and it is stated that these works will not under any circumstances raise the high water level of Lake Champlain above 'the present high water mark,' given as 101.5. Thus it is proposed to give the lake a range of 4.5 feet.

On page 324 of the report of the Board of Engineers upon deep waterways between the Great Lakes and the Atlantic tide waters is a tabular statement of the monthly mean discharge of Lake Champlain for the years 1875 to 1898, inclusive. An examination of this table shows that the period which gave the lowest discharge extended from September, 1882, to March, 1883; that which gave the next lowest extended from September, 1876 to March, 1877; that which gave the third lowest extended from September, 1883, to February, 1884; and that which gave the fourth lowest extended from August, 1894, to March, 1895. During these periods the amount flowing

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was less than 9,000 cubic feet per second, and in order to maintain that flow it would have been necessary to draw, from water previously stored for the purpose, the difference between 9,000 cubic feet and the amount which actually flowed.

	Cubic feet.
The deficiencies for the first period were.	58,803,840,000
Those for the second period were.	55,572,480,000
Those for the third period were.	51,278,400,000
Those for the fourth period were.	46,759,680,000

The area of Lake Champlain is 436.7 square miles, or 12,174,497,280 square feet. The depth required to store the deficiency during the first of the above periods is 4.81 feet; that for the second period is 4.56 feet; for the third period it is 4.21 feet; and for the fourth period it is 3.84 feet. Adding 1.25 for evaporation in eight months, those depths become 6.06, 5.81, 5.46 and 5.09 respectively. The range proposed, 4.5 feet, will therefore not be sufficient to provide 9,000 cubic feet per second throughout the low water season in very dry years.

A range much greater cannot be admitted without inflicting damage either upon the riparian owners or the navigation interests of Lake Champlain. In determining what is a proper high water and what a proper low water stage in this connection, it is not fair to take the extremes which the lake may have reached at long intervals in its history. A high water stage reached once in twenty years, for example, might inflict damage to property without destroying it, while if reached every year it might cause complete destruction; likewise the obstruction to navigation caused by an extreme low water stage would be greatly multiplied if repeated every year.

The table on page 323 of the Report on Deep Waterways quoted above, gives the monthly mean stages of Lake Champlain from 1875 to 1898. The highest stage there recorded is 100.13 for the month of April, 1896. Upon only two other occasions did the stage reach 100. To rise the level above 100 regularly every year would be to inflict an injury upon the riparian proprietors.

The mean elevation of the lake for the entire period was 96.10. The lowest stage reached was 93.65. During seven years it did not fall below 95. To allow the lake to be drained below 95 every year would be to inflict injury upon the navigation interests.

The limits between which the lake should be regulated are, therefore, 100 as a maximum and 95 as a minimum, notwithstanding that the reserve of water will not in very dry years be sufficient to supply 9,000 cubic feet per second.

As Lake Champlain is wholly within the territory of the United States, and the proposed works are wholly within Canadian territory, the international questions raised are of some moment. It is, in our opinion, not desirable that either nation should obstruct the natural flow of streams crossing the international boundary to the injury of public or private rights in the other. It is manifest, therefore, that the applicants should furnish conclusive evidence that private rights in the States of New York and Vermont adjoining Lake Champlain will not be injuriously affected by the alteration of the lake level as proposed, and that as the Secretary of War of the United States has control of the interests of navigation on Lake Champlain, the said work should not be undertaken without his permission and should be operated under such regulations as he may direct with a view to the maintenance of the level of the said lake as the interests of navigation thereon may require. It would be possible to plan works adapted to the conditions, and in our opinion such works should be permitted, provided they do not interfere with private interests in the United States and meet with the approval of the Secretary of War as suggested. We respectfully submit that in any treaty to be had between the two nations in relation to the use of international waters, the principles above suggested should have consideration. We would further suggest that the applicants' Canadian Act of incorporation should be amended so as to provide that the maintenance of the works sought to be erected shall be conditional at all times upon compliance with all regulations im-

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posed by the Secretary of War of the United States of America, from time to time for the preservation of the levels of Lake Champlain.

All of which is respectfully submitted.

GEO. C. GIBBONS,
Chairman, Canadian Section.

O. H. ERNST,
Brig.-General, U.S.A., Retired.
Chairman, American Section.

W. F. KING,
Commissioner.

GEORGE CLINTON,
Commissioner.

LOUIS COSTE,
Commissioner.

E. E. HASKELL,
Commissioner.

Attest,

Attest,

THOMAS COTE,
Secretary, Canadian Section.

W. EDWARD WILSON,
Secretary, American Section.

JOINT REPORT ON THE APPLICATION OF THE MINNESOTA CANAL
AND POWER COMPANY, OF DULUTH, MINNESOTA, FOR PERMIS-
SION TO DIVERT CERTAIN WATERS IN THE STATE OF
MINNESOTA FROM THE BOUNDARY WATERS
BETWEEN THE UNITED STATES AND
CANADA, 1906.

BUFFALO, N.Y., November 15, 1906.

To the Honourable the Minister of Public Works of Canada, and to the Honourable
the Secretary of War of the United States.

The International Waterways Commission would respectfully report that it has investigated as fully as existing data would permit the matters involved in the applications of the Minnesota Canal and Power Company, of Duluth, Minnesota, for the approval of its plans and structures to divert water from the Birch lake drainage basin in St. Louis and Lake counties, Minnesota, and for the use of certain public lands of the United States in said counties, and that it has heard the parties interested in said applications and those opposed. The physical data, outside of those furnished by the applicant, are few and not sufficient to show all the conditions existing. The applicant, however, has furnished maps and data which are not seriously contested by those opposing the applications, and they are considered sufficient to warrant the conclusions at which the commission has arrived, as set forth in this report.

The application of the Secretary of War of the United States is for the approval of certain plans for structures which will impound the waters of the Birch lake drainage basin, and divert them from that basin to Lake Superior, and for authorization to erect such structures and divert the waters.

The application to the Department of the Interior is for permission to use certain public lands, by flowage and otherwise, for the purpose of creating electrical power at Duluth, on Lake Superior. The Minnesota Canal and Power Company propose to divert water from the Birch lake drainage basin, which is naturally tributary to the Rainy river, Lake of the Woods, Winnipeg river and lake, and finally to Hudson bay. The quantity of water to be so diverted is mentioned in some of the documents before the commission as 600 cubic feet per second, but the company does not propose to limit itself to that amount if it be found, after the completion of its works as now planned, that a greater quantity can be obtained without injury to navigation interests. With 600 cubic feet per second about 30,000 electrical horse-power can be generated for use in Duluth and the mining regions of Minnesota.

The subject matter under consideration was called to the attention of the Canadian section of this commission by the Honourable the Secretary of State for Canada, in a letter dated January 6, 1905, in which, among other things, in stating the subjects that might come before the commission for its consideration, he mentions 'the proposed diversion southward by the Minnesota Canal and Power Company, of Duluth, of certain waters in the state of Minnesota, that now flow north into the Rainy river and the Lake of the Woods.' The same matter was called to the attention of the American section by a letter from the Minnesota Canal and Power Company, dated March 10, 1905, addressed to the chairman, in which the company referred to the application of the Power Company pending in the Interior Department, stating that it was advised that one of the subjects which would come before the commission for consideration is the proposed diversion southward of certain waters in the state of Minne-

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sota that now flow north into the Rainy river and the Lake of the Woods, and requesting that the matter be brought before the commission at the earliest practicable moment.

At a meeting of the commission, held June 15, 1905, this matter was laid over, for the reason that other and more pressing matters required the attention of the commission, and for the further reason that the jurisdiction of the commission over any waters except those in, or tributary to, the Great Lakes and the St. Lawrence river had been placed in doubt by the construction given by the government of the United States to the Act of Congress under which the commission was organized. The subject-matter having now been referred to the commission by the Honourable, the Secretary of War of the United States, and the Honourable, the Secretary of State for Canada, we regard our jurisdiction as fully established.

The Minnesota Canal and Power Company is a corporation organized under the laws of the state of Minnesota, with power to erect the works for the construction of which authorization is sought from the War Department of the United States, and with certain powers of eminent domain. It has heretofore brought proceedings in the District Courts of Minnesota for the purpose of putting into exercise the right of eminent domain and of condemning property and rights of persons who may be affected by the carrying out of its plans. The result of these proceedings has been an appeal to the Supreme Court of Minnesota, which has decided that the waters which would be affected by the carrying out of the Power Company's plans are public navigable waters, and that the statutes under which the company is organized do not, as an incident to the construction of a canal and the creating of a water-power, authorize a corporation to withdraw and divert waters from public navigable lakes and streams to such an extent as to interfere with present or future navigation, and by means of canals carry it over a divide and discharge it into a different drainage area, thus permanently withdrawing it from its natural course. This decision resulted in holding that the proceedings taken by the company to condemn property and rights of individuals must be dismissed.

The court says that 'In view of the presumption in favour of the rights of the individual, the state and federal prohibition against the obstruction of navigable waters, the rule that the rights of the state in such waters are sovereign and not proprietary, that they are held by the public as highways and cannot be alienable, the possible effect upon the rights of riparian proprietors in the province of Ontario, the fact that the doctrine of the appropriation of waters, adopted in some of the western states, does not prevail in Minnesota, and is not recognized by the conventional law of nations, the treaty relations between the United States and Great Britain with reference to the boundary waters between the United States and Canada, and that the taking of the waters would interfere with streams and lakes which are already devoted to public uses, which can only be done under express statutory authority,' it is constrained to hold that the appellant is not authorized to condemn the interests sought to be condemned. The applicant, assuming that the decision of the Supreme Court, adverse to it would be adhered to only upon the ground that its petition included private as well as public uses, has filed another petition making the purposes for which condemnation will be sought wholly public and has begun new condemnation proceedings.

Objections and protests have been filed with the commission on behalf of various interests opposed to the granting of the Canal and Power Company's application. These objections may be divided into two classes: first: objections made by parties claiming that they have interests and property rights in the state of Minnesota which will be affected by the carrying out of the Canal and Power Company's plans; and second: objections made by parties having interests in the boundary waters in the state of Minnesota and in Canada, which it is claimed will be affected by the proposed diversion of the waters of the Birch lake drainage area.

The first class of objectors includes Frederick B. Spelman, who claims to be the owner in fee of valuable water rights on Birch river; the Northeastern Minnesota Power Company, a corporation organized under the laws of the state of Minnesota for

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the purpose of generating electricity by water power, and distributing and selling the same, which claims that it is the owner of certain real estate in Lake County, Minnesota, bordering on Kawishiwi falls; the St. Croix Lumber Company, and the Fall Lake Boom Company, corporations organized under the laws of the state of Minnesota, which, acting together, are engaged in the manufacture of lumber in the state of Minnesota, and using, for the purpose of bringing logs to the mills of the lumber company, waters which would be affected by the diversion contemplated by the Canal and Power Company, and which companies also have certain property interests in Minnesota; and Lazarus Silverman, representing the Enterprise Iron and Land Company, which has valuable land and water interests in Minnesota. It is understood that the interests of the last named company are owned or controlled by the Northeastern Minnesota Power Company. Others having interests in the United States are the Hope Land Company, the Higgins Land Company and the Higgins Wild Cat Company, who object on the ground that the reservoir proposed will flood their lands, and the Duluth and Iron Range Railroad Company, which protests against the projected work as being 'an improper and unwarranted use of the international waters.'

The property, rights and interests of all these parties will be injuriously affected, to a greater or less extent, in case the Minnesota Canal and Power Company is permitted to impound the waters of the Birch lake drainage basin and divert them to Lake Superior from the streams flowing into the boundary waters. The commission, however, is of the opinion that the rights and interests of these parties can be properly protected under the laws of the state of Minnesota. We, therefore, conclude that their objections do not present any international questions, and such questions alone the commission considers as having been referred to it.

The second class of objectors include the corporation of the town of Fort Frances, in the province of Ontario, which claims to have valuable navigation advantages upon Rainy river, long recognized as an international waterway; the Koochiching Company, a corporation organized under the laws of the state of Iowa, the owner in fee simple of a section of land bordering on Rainy river at Koochiching falls, opposite Fort Frances; the Rainy River Improvement Company, a corporation organized under the laws of the state of Minnesota, for the purpose of improving the navigation of the boundary waters by means of dams and canals to be constructed at Koochiching falls and elsewhere, for the development of water power at the Koochiching dam, and for the transportation of logs; and Edward W. Backus, of Minneapolis, who has entered into a contract with the government of Ontario, by which he has agreed to construct a dam across the Rainy river and develop power at the Koochiching falls, which agreement is now understood to be assigned to the Ontario and Minnesota Power Company, a corporation organized under the laws of Canada. It is understood that the Koochiching Company, the Rainy River Improvement Company, Edward W. Backus and the Ontario and Minnesota Power Company are associated and are acting in concert. The Rainy River Navigation Company and the city of Winnipeg also object to the proposed diversion.

These interests strenuously object to the carrying out of the plans of the Minnesota Canal and Power Company, claiming that diminution of water by reason of the proposed diversion in the streams which they propose to utilize will greatly injure their navigation interests and their ability to produce electric power.

In addition to these objections of individuals, the Canadian government, acting upon a memorial of the municipal corporation of Fort Frances, addressed to the Canadian Minister of Marine and Fisheries, brought the proposed diversion to the attention of the British Ambassador at Washington for his information and such action as might be possible in the premises. A copy of this memorial is hereto attached, marked 'A.' Upon receipt of the communication from the Canadian government, the British Ambassador presented the matter to the Secretary of State of the United States, on January 3, 1905, requesting that the proposed diversion be not carried out pending the meeting of this commission.

At a hearing before the commission, held at Buffalo on June 26, 1906, Col. Anderson, chief engineer of the Department of Marine and Fisheries of Canada, and Mr.

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J. G. Sing, engineer in charge of the Rainy River district of the Department of Public Works of Canada, appeared and opposed the proposed diversion on the ground that it would be detrimental to Canadian interests and especially to navigation upon the boundary waters. At a meeting of the commission, held in Toronto on July 24, 1906, written objections were presented as follows, viz.: A resolution of the municipal council of the town of Kenora, Canada, a copy of which is hereto annexed, marked 'B,' a letter from Mr. George A. Graham, manager of the Rainy River Navigation Company, a copy of which is hereto annexed, marked 'C,' a resolution of the Kenora Board of Trade, a copy of which is hereto annexed, marked 'D,' and a written statement by Mr. Sing, hereto annexed, marked 'E.'

At a meeting of the commission, held at the city of Chicago, Illinois, on the 17th day of October, 1906, H. N. Ruttan, city engineer of the city of Winnipeg, Canada, appeared before the commission in opposition to the application of the Minnesota Canal and Power Company. After stating that the probable head available for power purposes between Rainy lake and Lake Winnipeg, on the Winnipeg river, approximates three hundred feet, that the discharge of Winnipeg river at Point du Bois falls, in the province of Manitoba, was nineteen thousand cubic feet per second in March, 1906, and that the discharge at extreme low water might reach a maximum of seventeen thousand cubic feet per second, that works had been completed and were in course of construction between Rainy lake and Lake Winnipeg, aggregating approximately one hundred and fifty thousand horse-power, involving an expenditure of between fifteen and twenty millions of dollars, and that many additional powers are projected, some of which will no doubt be constructed, that the city of Winnipeg has a population of one hundred thousand, which is rapidly increasing, and has voted to construct a water power at Point du Bois, at a cost estimated at three and one-quarter millions of dollars for preliminary development, Mr. Ruttan, on behalf of the city of Winnipeg, objected to the diversion of water which naturally belongs to the Winnipeg watershed.

The action of the British Ambassador, at the request of the Canadian government, together with the fact that the rights and interests of Canadian citizens will be affected by the carrying out of the plans of the Minnesota Canal and Power Company, and the fact that navigation of boundary waters will be to some extent injured if such plans are put in operation, presents international questions, which, in the opinion of this commission, will be involved in many other instances of boundary streams between the two countries and require the most careful consideration. In order that there may be no question as to the exact intent of the commission in giving its conclusions, it is deemed best to state with as much exactitude as possible the existing conditions which give rise to the questions to be disposed of.

The commission finds the physical conditions of the locality to be as follows: The Birch Lake Drainage Basin is situated in the counties of St. Louis and Lake, in the State of Minnesota, the border of the basin being only about fourteen miles from Lake Superior. This drainage basin contains a chain of small lakes, the largest of these known as Birch lake, lying near the western border of the basin. A portion of the drainage of this basin flows westerly through the North Kawishiwi river and Farm lake to Garden lake, with a fall of about fifty-six feet in the distance of nine miles; another portion flows southwesterly through the south Kawishiwi into Birch lake, and thence northerly through Birch river and White Iron lake to Garden lake, the distance traversed by the waters along this route being about twenty-four miles. Passing Kawishiwi falls, the waters, continually increasing in volume, flow through Fall lake over the Pipestone falls to Basswood lake, lying on the international boundary between the United States and Canada; the waters thence flow in a general northwesterly direction through Crooked and Iron lakes, Lac la Croix, Namakan river and lake, to the Rainy lake, and thence through Rainy river to the Lake of the Woods. From Basswood lake to the Lake of the Woods the waters flow along the international boundary line with the exception of about twenty miles, where they traverse the Namakan river, entirely in Canadian territory.

Within two miles of the western end of Birch lake, and separated from it by a low divide, rises the Embarrass river, its waters flowing southwesterly through Sabin,

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Embarrass and Esquagamau lakes into the St. Louis river, and thence into St. Louis bay and Lake Superior. The St. Louis bay and river form a portion of a boundary between Minnesota and Wisconsin and are navigable from Lake Superior to Fond du Lac, Minnesota. From Fond du Lac to Cloquet the St. Louis river is unnavigable, there being a fall of approximately six hundred feet in a distance of fourteen miles; above the latter point it is used to float logs, about twenty-five million feet, it is said, being transported annually.

The natural waterway from Birch lake to Rainy lake may be described as a series of pools of greater or less extent connected by short and shallow channels containing rapids or falls. The pools or lakes are capable of floating logs and are in general navigable by small steamboats; but the connecting channels are, in their natural condition, not navigable save by canoes or small boats and in places are wholly unnavigable, some of them being even incapable of floating logs, except at times of high water. The channels connecting Birch lake with the lakes directly north are of this character and a dam has been erected at the outlet of Birch lake for the purpose of raising the water and floating logs over the rapids by means of the greater flow made available by opening gates; and at the outlet of Garden lake a roll dam has been built to serve a similar purpose.

Navigation upon Birch lake is confined to canoes and rafts of logs which are towed by a small tug called a log puller. This tug was built upon the lake and under present natural conditions is confined to its waters. Similar conditions prevail on White Iron and Garden lakes, the pools next below or north of Birch lake, a steam log puller being operated on each. About twenty million feet of logs are said to be transported annually from Birch lake and vicinity to a saw-mill on Fall lake.

Between Birch Lake and Rainy lake the only through navigation is by canoes and it is said that there are no less than eighteen places at which portages are required by reason of the waterfalls and rapids.

Basswood and Crooked lakes, Lac la Croix and Namakan lake are all navigable and it is understood that they are not only used for the floating of logs but that one or more small tugs or log pullers are in use upon each of them, although through navigation by boats is not possible. There have been at least two small steamboats operating on Basswood lake having a gross tonnage of three and ten tons respectively.

Rainy lake is a navigable waterway and several steamboats of small tonnage are operating upon it. There are two points in this lake restricting the navigable depth. One of these is known as the 'Brulé Narrows,' about midway of its length, and the other is at Pither's Point, at the outlet of the lake and just above Koochiching falls. The depth at these points in ordinary low water is about seven feet and it is understood there have been years when the larger boats were laid up on account of low water. The allied interests represented by the Rainy River Improvement Company on the American side and the Ontario and Minnesota Power Company on the Canadian side are engaged in building dams at Fort Frances above Koochiching falls for the purpose of improving the water power, and thereby incidentally improving the navigability of Rainy lake by raising the elevation of its water surface.

There are two, and possibly more, steamboats operating on Rainy river, and making regular trips between Fort Frances at the Koochiching falls and Rat Portage on the Lake of the Woods, and touching at way ports.

The only improvement made by the United States government on any of these waterways is at the harbour of Warroad, Minnesota, which has been improved to a depth of seven feet below the stage of water at the time of making the survey. The elevation of the Lake of the Woods, and consequently the depth of water in the harbour, is controlled by the operation of the Keewatin dam at Rat Portage, which is operated under the direction of the Canadian Government. The Annual Report of the Chief of Engineers, U.S.A., 1904, gives the following statistics regarding the commerce of the town of Warroad:

'The town of Warroad, now four years old, has a population of 700, and the adjacent country is rapidly filling up with settlers. The imports of Warroad increased

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from 254 tons in 1900 to 2,754 tons in 1904. During the same period the exports increased from 1,215 tons to 9,929 tons.

In the report of 1905, the following statement is made:

‘The town of Warroad, now five years old, has a population of about 1,000, and the adjacent country is rapidly filling up with settlers.

‘Up to this time Warroad Harbour has had no regular lake traffic, the condition of the entrance to the harbour not having been such as to permit it.

‘On the Lake of the Woods there are at present 25 or more registered Canadian boats, ranging from 30 to 486 tons burden, some of which occasionally visit Warroad Harbour when conditions are favourable.

‘The United States boats connected with Warroad Harbour are the propellers Na-ma-puk and Knute Nelson, the former about 36 feet long and the latter about 80 feet.’

The Canadian government has made slight improvements above the Lake of the Woods and an agreement has been made between the Commissioner of Crown Lands for the Province of Ontario and E. W. Backus, who subsequently transferred his rights to the Ontario and Minnesota Power Company, whereby in return for certain water power privileges the latter is required to construct a dam at Koochiching Falls to be subject to the control of the government, making it possible to maintain the water level in Rainy Lake at or above the present extreme high water stage.

The country traversed by the waterway leading from Birch lake to Rainy lake is in general rough and unimproved. The timber consists of white and Norway pine, spruce and less valuable woods, typical of Lake Superior forests. The pine is being rapidly cleared from some of the larger tracts. The Vermillion and Mesabi iron districts cross the territory between Birch lake and the boundary line, and the soil is shallow and not well suited to agriculture.

The population, in 1900, of the townships bordering the waterway from Birch lake to and including Basswood lake, did not exceed 4,000, the town of Ely having a population of 3,717. This sparse population depends largely upon the mining and timber industries of the locality. The population of the townships on the American side bordering the waterway from Basswood lake to and including the Lake of the Woods, and covering about 200 miles of shore line, was only about 600 according to the census of 1900. The country bordering the Lake of the Woods on the Canadian side is fairly well settled. On the American side it is wilderness composed largely of Indian reservations, portions of which have been thrown open to settlement. The vicinity of Warroad has been recently so opened.

At several places along the waterway from Birch lake to Rainy lake, development of water power is possible, but at most of them it is not commercially feasible at present, for the following reasons: A considerable fall is not usually concentrated at one point, but is distributed over rapids; the flow is not uniform, but is very small during the dry season, and, unless the waters of the flood season are impounded, the extent of the possible continuous development is restricted by the low water flow; the construction of reservoirs would entail a heavy expenditure in proportion to the possible development; the demand for power in the vicinity is extremely limited.

The Kawishiwi falls may be an exception to this general rule and the development of this power may be commercially practicable in the near future, if not at present. In this case there is a fall of about 65 feet in three-quarters of a mile between Garden Lake and Fall lake, and by the construction of a reservoir system similar to that proposed by the applicant, there would be available about 6,000 theoretical horse-power. A market for this power could probably be found at Ely and in the mines in the locality.

Between Birch lake and White Iron lake there is a natural fall of about 28 feet. If the North Kawishiwi outlet of Birch lake were closed by a dam, and an extensive reservoir system constructed similar to that proposed by the applicant, there would be available at this point about 2,500 theoretical horse-power.

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Below Kawishiwi falls and between the outlet of Fall lake and Basswood lake there is a fall of about 15 feet in less than three miles. By using 820 cubic feet per second, which is the minimum flow, plus the amount of water to be diverted, there would be available about 1,500 theoretical horse-power.

The value of the three water-powers last mentioned, whether present or prospective, would be practically extinguished by the applicant's proposed works, but, as before stated, the rights of their owners can be properly protected under the laws of Minnesota.

At Koochiching falls in the Rainy river, just below the outlet of Rainy lake, there is a natural fall of about 23 feet in a short distance. The minimum discharge of the river has been estimated at 3,500 cubic feet per second. This volume would give about 7,800 theoretical horse-power without storage, and by raising the water level of Rainy lake five to seven feet by means of dams above Koochiching falls it would be possible to double this development. Even this would permit the utilization of less than half of the average outflow. Unless an extensive reservoir system is constructed, therefore, including the lakes nearer the head waters, at least one-half of the waters of the basin tributary to Rainy lake, or more than ten times the quantity of water proposed to be used by the applicant, will serve no useful purpose for power development at this point.

The improvements for which the applicant now asks approval are as follows: To erect a dam at the mouth of Gabbro lake to impound water in the lakes tributary thereto and form what is called the Isabelle Reservoir; to erect a dam in the North Kawishiwi river to impound the waters in the lakes and streams tributary to Birch lake naturally flowing westerly into White Iron and Garden lakes; to erect a dam in the South Kawishiwi river, which, in connection with the dam last mentioned, will form the Kawishiwi reservoir; and to erect a dam in Birch river at the outlet of Birch lake to impound its waters and form the Birch Lake reservoir. The company proposes to cut a canal from the west end of Birch lake a distance of about six miles across the divide to the head waters of the Embarrass river and to erect controlling works at the entrance to this canal to regulate the flow of water from Birch lake into the Embarrass river canal. From a point in the St. Louis river above Cloquet it proposes to dig another canal about twenty-four and one-half miles long to a point in the city of Duluth, where the bluff is about 600 feet above the water level of Lake Superior, and to lay pipes from the easterly end of this, the St. Louis river canal, to the power-house of the company to be erected on the shores of St. Louis bay. It is proposed to divert at least 600 cubic feet of water per second from the Birch Lake reservoir into the Embarrass canal and river, and thence into the St. Louis river, and to take the same amount from the latter into the St. Louis river canal and convey it by canal and pipes to the turbines located in the company's power-house, thereby developing about 30,000 electrical horse-power; the amount of water diverted and of power created to be increased hereafter if circumstances permit.

The amount of water the company proposes to divert from the natural channels leading to Basswood lake, and thence along the international boundary, is estimated to be about 37 per cent of the water tributary to Basswood lake, four per cent of that tributary to Rainy lake, and two and four-tenths per cent of that tributary to the Lake of the Woods.

The data available covering the hydraulic conditions are inadequate for an accurate analysis of the effect of the work proposed by the company, since the distribution of the supply and the discharge of the outlets of the several lakes throughout the year have not been determined. The effect on the navigable depth of Rainy lake and the waterway below that point would be very slight under natural conditions and become still less important by reason of the fact that the elevation of Rainy lake will be controlled by the Koochiching dam, when completed, as the elevation of the Lake of the Woods is now controlled by the Keewatin dam. The company offers no objection to the suggestion to conserve navigation interests by the construction of such remedial works as may be necessary. While the data are insufficient to determine the extent of the remedial works required, they are sufficient to warrant the belief that full compensation is possible.

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The minimum discharge from Birch Lake drainage basin is estimated by the engineers of the company to be about 220 cubic feet per second and the average discharge about 975 cubic feet per second. The reservoir system created by the dams proposed by the company will permit of storing a portion of the waters during months of excessive supply for use during the remainder of the year when the natural supply is deficient.

From April to June inclusive the supply to the lakes is greatly in excess of the natural discharge, and in July, August and September the supply in a year of ordinary precipitation is probably in excess of the amount to be withdrawn by the applicant. It would appear, therefore, that the reservoirs might in general be kept full until October first. The reservoirs proposed by the applicant are sufficient to store eight billion, nineteen million cubic feet of water, and it is claimed that this capacity might be doubled by an extension of its works, without interference with other watersheds draining north. If the proposed smaller capacity reservoirs were full on October first, the applicant could withdraw its own supply entirely from the reservoirs for five months and still permit the natural supply of the lakes during this low water period to flow in the present channel. Under such conditions the usual low water discharge of Birch and North Kawishiwi rivers would be depleted by the amount of water now supplied by the lakes tributary to them; namely, by the natural decrease in stage of those lakes during low water. It would be possible to require the company to maintain at all times a flow in the natural channel equal to the present estimated minimum discharge, without disastrously affecting the applicant's plans.

The lakes could be held at or above the present elevation by a dam properly constructed at the outlet of each, and the future improvement of the stream, in general, by locks and dams, would not be impaired when prospective commerce demands such a step. In order, however, to accommodate the commerce now existing or in prospect between adjoining lakes above Rainy lake, namely, the transportation of logs over rapids and falls, the gates in these dams would have to be operated with regard to the necessities of commerce rather than to serve the interests of the applicant and should be so operated.

In a report upon this subject addressed to the Chief of Engineers, U. S. Army, by Major Geo. McC. Derby, May 24, 1905, Major Derby enumerated the conditions under which he considered the application should be granted, and the applicant appears to be willing to accept these conditions, which include the following:

'The Minnesota Canal and Power Company should construct and maintain a dam or dams in Lake Namakan, or at some other point or points above Rainy lake, so as to impound and store during periods of high water, when it would otherwise go to waste, an amount of water equal to the entire amount diverted from the watershed of Rainy lake, releasing this water into Rainy lake from time to time as the interests of navigation in Rainy river and above may require, in accordance with regulations to be made by the Secretary of War.'

'The Minnesota Canal and Power Company should construct and maintain such additional dams as may be necessary to maintain Basswood lake and the other lakes between Birch lake and Rainy lake at or above their mean level; and should release from all such dams from time to time such amount of water as may be necessary to sluice logs from one lake to the next, and for other interests of navigation, in accordance with regulations to be made by the Secretary of War.'

It is quite apparent that the interests to be promoted at the city of Duluth, and at the Minnesota mines, by the generation and transmission of electricity, if the diversion be permitted, will be very great, the amount of horse-power which will be available being about 30,000.

The canal which the applicant proposes to construct, and the improvement of the lakes and streams south of the Birch lake drainage area, will furnish additional aids to navigation, particularly for the transportation of logs cut in the forests within that area.

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INTERNATIONAL ASPECT OF QUESTIONS INVOLVED.

The proposed diversion, so far as it would affect navigation upon boundary waters, presents a serious objection to the granting of the permit asked.

By the terms of article II. of the treaty of 1842, between the United States and Great Britain, the boundary line from a point in the Neebish channel, where the commissioners appointed under the sixth article of the treaty of Ghent ended their labours, was defined westward to the Rocky mountains. In that article there is added to the description this sentence:

‘It being understood that all the water communications and all the usual portages along the line from Lake Superior to the Lake of the Woods, and also Grand Portage, from the shore of Lake Superior to the Pigeon river, as now actually used, shall be free and open to the use of the citizens and subjects of both countries.’

This clause secures to Canada free and unobstructed navigation of the boundary waters from which the proposed diversion is to be made. In the opinion of the commission it secures to Canada, by necessary construction, the right to navigate those waters in any manner which the natural flow will permit. Any interference with the natural flow which decreases the navigable capacity of Basswood lake, Rainy river, Rainy lake or the Lake of the Woods is a violation of the letter and spirit of the treaty, and the extent of the interference is not important; if the navigable capacity is injuriously affected, Canada has the right to object. Nor does the possibility of restoring and regulating the flow in the boundary waters mentioned, by remedial works, confer any right to lessen the navigable capacity, for such works will have to be constructed in part in the Dominion of Canada and this cannot be done without Canada’s consent, nor can the burden of constructing such works be imposed upon her.

The commission is aware that the clause of the treaty of 1842, quoted, has received a different construction from that which we place upon it. It has been said that the phrase ‘as now actually used’ applied to the use of the waters, and that, as at the time the treaty was entered into those waters were used for canoe navigation only, the treaty secures the right of canoe navigation and nothing more. This construction seems to us erroneous. The language of the clause secures the free and open use of the waters specified and the use of Grand Portage, as it was then ‘actually used.’ We deem it quite clear upon the face of the treaty that this was the intention of the treaty powers. The clause we are considering is divided into two subjects: one is the free and open use of the water communications and usual portages, and the other is the use of Grand Portage, and the subject matters are separated by the expression ‘and also,’ which would seem clearly to make the expression ‘as now actually used’ relate to the Grand Portage, inasmuch as that is introduced by the expression ‘and also.’ This construction would seem to be supported by the conditions existing at the time the treaty was negotiated and also by the obvious purpose of the treaty. When the treaty was entered into, the navigable waters on the boundary line west of Lake Superior were connected by portages, which were reasonably well defined and which naturally would be followed, but the Grand Portage, extending from Lake Superior overland to the Pigeon River, was of great length and subject to considerable change in accordance with the views of those who might use it from time to time. It was clearly necessary to define the Grand Portage by some description in the treaty, and this was done by inserting the phrase ‘as now actually used.’ It was evidently the intention of the treaty-making powers, in defining the boundaries, to secure to both countries the free and open use of the boundary waters for interior communication and transportation, and it would seem to be a narrow construction of the clause in question which would assign to those powers the intent to limit the right of communication and transportation to canoes, for this would place them in the position of utterly ignoring future conditions and practically destroying the value of the waterways as means of communication. The broader and proper construction, in the opinion of the commission, is that the intent was to preserve to both countries the ‘free and open use’ of the

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boundary waters, in any matter that they could be made use of for the purposes mentioned.

In the opinion of the commission, therefore, the permit to permanently divert waters which would supply the boundary lakes and streams, ought not to be granted without the concurrence of the Dominion of Canada.

Aside from the effect of the treaty of 1842, there are other considerations which lead the commission to the conclusion that the permit applied for should not be granted without the concurrence of Canada.

The proposed diversion will, to some extent, injuriously affect riparian rights upon the Canadian side of the boundary waters and will also affect the water supply of the Namakan river and other waters, wholly in Canada. The principles involved in arriving at this conclusion do not impugn the right of the United States to grant the permit, but they are of such great importance and of such widespread application that the commission believes they should be settled and applied by both countries.

As the necessity for an enormous increase in the appropriation of water wholly within one country has given rise in later years to conditions which never existed before, recourse to authorities upon international law for direct precedents is useless, but there are certain principles of international law which have a direct bearing upon the question under consideration and which should, in the opinion of the commission, be sufficient for their solution.

It can hardly be disputed that, in the absence of treaty stipulation, a country through which streams have their course or in which lakes exist, can in the exercise of its sovereign powers, rightfully divert or otherwise appropriate the waters within its territory for purposes of irrigation, the improvement of navigation, or for any other purpose which the government may deem proper. This principle was lucidly stated by Mr. Harmon, Attorney General of the United States, on December 12, 1895, in a communication to the Secretary of State (opinions of Attorneys General, Vol. 21, p. 274). The question submitted to the Attorney General by the Secretary of State involved the right to appropriate the waters of the upper Rio Grande for irrigation purposes to the injury of residents of Mexico, and in giving his opinion the Attorney General laid down the law as follows: 'The fundamental principle of international law is the absolute sovereignty of every nation, as against all others, within its own territory.' He then quoted from Chief Justice Marshall's opinion in *Schooner Exchange vs. McFadden*, 7 Cranch, p. 136, the following excerpt:

'The jurisdiction of the nation within its own territory is necessarily exclusive and absolute. It is susceptible of no limitation not imposed by itself. Any restriction upon it, deriving validity from an external source would imply a diminution of its sovereignty to extent of the restriction, and an investment of that sovereignty to the same extent in that power which could impose such restriction.

All exceptions, therefore, to the full and complete power of a nation within its own territories must be traced up to the consent of the nation itself. They can flow from no other legitimate source.'

Great Britain also has insisted upon the same principle in the matter of the navigation of the lower St. Lawrence. The history of the positions taken by the United States and Great Britain need not be recited, but it will be noted that Great Britain did not recede from her position and simply conceded by treaty the right of navigation upon certain concessions being made by the United States. It would seem, therefore, to be settled international law, recognized by both countries, that the exercise of sovereign power over waters within the jurisdiction of a country, cannot be questioned, and that, notwithstanding such exercise may take a form that will be injurious to another country through which the waters of the same streams or lakes pass, it cannot be rightfully regarded as furnishing a cause of war. But where the citizens of a country are injured by such exercise of sovereignty, international law recognizes (unless there is urgent necessity for its exercise), that there is a breach of comity which entitles the country whose citizens or subjects are injured, to retaliate. Sir Robert Phillimore, in his commentaries upon international law (edition of 1879, pp 12 and 13), clearly draws the

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distinction between the international duties of governments as they affect public interests and as they affect private interests. He states the international law as follows:—

‘The *obligationes juris privati inter gentes* are not—as the *obligationes juris publici inter gentes* are—the result of legal necessity, but of social convenience and they are called by the name of comity—*comitas gentium*.

‘It is within the absolute competence of a state to refuse permission to foreigners to enter into transaction with its subjects, or to allow them to do so, being forewarned that the municipal law of the land will be applied to them; therefore, a breach of comity cannot, strictly speaking, furnish a *casus belli*, or justify a recourse to war, any more than a discourtesy or breach of a natural duty, simply as such, can furnish ground for the private action of one individual against another.

‘For want of comity towards the individual subjects of a foreign state, reciprocity of treatment by the state whose subjects has been injured, is, after remonstrance has been exhausted, the only legitimate remedy; whereas the breach of a rule of public international law constitutes a *casus belli*, and justifies in the last resort a recourse to war.’

It would seem that comity would require that, in the absence of necessity, the sovereign power should not be exercised to the injury of a friendly nation or of its citizens or subjects, without the consent of that nation.

The common law protects riparian owners against permanent diversions of water which injuriously affect their rights, and this law is founded upon principles, not merely of social necessity, but of justice and right. While the common law is not a part of the law of nations, its principles so far as they are founded in justice and equity, ought, where practicable, to be applied by nations acting in their sovereign capacity. The Department of State of the United States has adopted this principle in the past, and although the application was made in the case of conflicting riparian rights on a boundary stream, yet the commission can see no sound distinction between the position taken by the government of the United States in the case referred to, and cases of diversion of water wholly within one country where the diversion injuriously affects riparian owners in another country. This application of the common law was made by Mr. Evarts, Secretary of State. It was complained that Mexicans upon the Rio Grande in the neighbourhood of El Paso, were diverting so much of the waters of the river for irrigation purposes as to seriously affect the amount which could be obtained by citizens of the United States for a like purpose. Mr. Evarts in a communication to Mr. Navarro, the Mexican Minister (June 15, 1880), directs his attention to the complaints, and after referring to the abstraction of water by the Mexican population for irrigation purposes, says:

‘As this is not only in direct opposition to the recognized rights of riparian proprietors, but is also contrary to that good feeling and harmony which ought to exist between co-labourers in peaceful pursuits, and might, moreover, if permitted to continue, result in bitter feeling and possible breaches of the peace, I most earnestly request, in these high interests, that you will have the goodness to bring the matter to the attention of your government with a view to procuring a cessation of the annoyance complained of.’ (Vol. 1, p. 63, Wharton’s International Law Digest.)

Mr. Farnham, while somewhat over-stating the law, in his work on ‘Waters and Water Rights’ (edition of 1904, vol. 1, p. 29), forcibly enunciates the principles which should obtain, citing authorities.

‘A river which flows through the territory of several states or nations is their common property. Each is entitled to its navigation throughout its whole extent, so far as it can be exercised without injury to the rights of others. It is a great natural highway conferring, besides the facilities of navigation, certain incidental advantages such as fishery and the right to use the water for power and irrigation. Neither nation can do any act which will deprive the other of the benefits of these rights and advantages. The inherent right of a nation to protect itself and its territory would justify the one lower down the stream in preventing by force the one further up from turning the river out of its course, or in consuming so much of the water for purposes of its own as to deprive

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the former of its benefit. Conversely, the upper owner would have a right to prevent an obstruction of the stream which would prevent fish from ascending to its shores, or interfere with its rights of navigation. To prevent resort to force, courts of arbitration would protect these rights, and the courts of the respective nations will prevent acts on the part of their own subjects which interfere with the rights of subjects of other states. And courts having a supervisory jurisdiction over the acts of the political department of government will prevent acts by that department which will injure the rights of neighbouring states. The gifts of nature are for the benefit of mankind, and no aggregation of men can assert and exercise such rights and ownership of them as will deprive others having equal rights, and means of enjoying them, of such enjoyment. The acts of nations must be governed by principles of right and justice. The days of force and self-aggrandizement at the expense of neighbouring nations are past, and the common right to enjoy the bountiful provisions of Providence must be preserved.'

Messrs. Jeremiah Smith and George B. French very fully and ably discuss in the *Harvard Review*, November, 1894, volume 8, number 3, the power of a state to divert an inter-state river. They said: 'Because Massachusetts can compel a sale of property in Massachusetts, it does not follow that it also can compel a sale of property in New Hampshire. Massachusetts has not the power to compel a New Hampshire riparian proprietor to sell his right (annexed to and arising out of his New Hampshire land), that the water of the river should continue to flow to his land. A state cannot exercise the power of eminent domain extra-territorially. Massachusetts cannot condemn land in New Hampshire. Massachusetts cannot, as against a citizen of New Hampshire, authorize the doing of an act in Massachusetts which will result in the taking of property rights in New Hampshire. Massachusetts could not authorize the building of a dam in Massachusetts which would flood land in New Hampshire.'

'By parity of reasoning, Massachusetts could not authorize the construction of an aqueduct or canal in Massachusetts which would divert water from a stream naturally flowing to New Hampshire. The right infringed by flooding New Hampshire land may be called absolute ownership. The right infringed by diverting water from the New Hampshire land may be called an easement. The consequence in the one case may be positive, and in the other case negative. But in each case it is a property right that is infringed; and the consequence is as direct in the latter case as in the former. * *

* Massachusetts, even if an entirely distinct and independent sovereignty—even if standing to New Hampshire in the relation of France to Spain—would not have a right, under the rules of international law, to do this act. The law of nations recognizes no such right, even between states wholly foreign to each other. * * * * * Massachusetts instead of merely denying New Hampshire's right to use, in Massachusetts, that part of the river which naturally flows through Massachusetts, is, in effect, denying New Hampshire's right to use, in New Hampshire, that part of the river which naturally flows through New Hampshire. Massachusetts, instead of saying to New Hampshire, "You shall not hereafter use, in Massachusetts, that part of the common river which flows through Massachusetts," makes a far more startling declaration. Massachusetts says to New Hampshire, "You shall not hereafter have the use of the river even within your own borders, for Massachusetts denies your right to have any part of the river flow through New Hampshire."'

These principles were applied in the *Holyoke Water Power Company vs. Connecticut River Company* (22 Blatch 131, 20 Feb., '71).

In this case the plaintiff claims that its property located in Massachusetts would be injured by the defendants raising of a dam in the State of Connecticut. The defendant justified under powers given it by the State of Connecticut claiming that its proposed structure was in aid of navigation. A permanent injunction was granted enjoining the defendant.

The court, after holding that the State of Connecticut had jurisdiction over lands within its boundaries says, 'As Connecticut has no direct jurisdiction or contral over

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real estate situate in another state, it cannot indirectly, by virtue of its attempted improvement of its own navigable waters, control or subject to injury foreign real estate.

‘If this resolution is a bar to an action for any consequent injury to land or to rights connected with land in Massachusetts, Connecticut is acting extra-territorially.’

CONCLUSIONS.

The commission has arrived at the following conclusions:

1. While the work proposed by the applicant will be of great advantage to the interests served, it will interfere with public and private interests in Canada, and the commission see no public necessity for it.

2. The proposed diversion will injure the interests of various classes of persons, namely, residents of the United States having property rights in the State of Minnesota, residents of the United States having property rights and interests in Canada and in the boundary waters, residents of Canada having property rights and interests in Canada, and municipalities in the Dominion of Canada. The rights and interests which will be affected are divisible into two classes, namely, those which depend upon navigation directly or indirectly, and those which depend upon the use of waters of the various streams and lakes for power purposes.

3. The proposed diversion will affect injuriously navigation upon the boundary waters between the United States and Canada, above mentioned, and upon navigable waters in Canada connecting said boundary waters; but,

4. So far as water power interests on the international boundary or in Canada are concerned, which depend upon the supply from the Birch lake drainage area, although remedial works at locations above Rainy lake may be constructed, the total amount of water which can be stored and used for power purposes upon the boundary and connecting waters located wholly in Canada, will be diminished.

5. The applicant, the Minnesota Canal and Power Company of Duluth, Minnesota, under the decision of the Supreme Court of Minnesota, above cited, apparently has not the power to utilize the permit it seeks to obtain, but possibly may acquire that power. It would seem, therefore, that the permit which the applicant seeks, ought not in any case to be granted before it secures authority under the laws of Minnesota to utilize it.

6. That the rights and interests of the residents of Minnesota which may be affected by the proposed diversion, are of so much less importance than the interests which will be promoted by the proposed works of the applicant, that they do not furnish a sufficient reason for refusing the permit sought, inasmuch as full compensation must be made to such persons under the laws of Minnesota.

7. Neither the State of Minnesota nor the United States can provide the adequate means by which money compensation can be ascertained and made to the owners of the interests in Canada which may be injured, and it follows that individuals sustaining injury would be relegated to litigation. This is a violation of the principle of law that private property shall not be taken for public use, unless provision for compensation can be made without litigation and its attendant delays and expense.

8. So far as remedial works are concerned, it is sufficient to say that there is no jurisdiction in the United States or in the State of Minnesota to provide for or permit the erection of the necessary remedial works in Canada.

9. That although it might be advisable to grant the permit applied for, in case the applicant should acquire the powers necessary to utilize it, if objections arising from international relations did not exist, treaty provisions, international comity and the impossibility of providing just means of assuring adequate compensation for injury to interests in Canada, or of preserving navigation unimpaired on the boundary streams, without concurrent action of both governments concerned, lead us to the

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conclusion that the permit should not be granted unless the full protection of all interests not cared for by the laws of Minnesota be secured by concurrent action of the United States and Canada.

RECOMMENDATIONS.

1. The commission would, therefore, recommend that the permit applied for be not granted without the concurrence of the Canadian government.

2. As questions involving the same principles and difficulties, liable to create friction, hostile feelings and reprisals, are liable to arise between the two countries, affecting waters on or crossing the boundary line, the commission would recommend that a treaty be entered into which shall settle the rules and principles upon which all such questions may be peacefully and satisfactorily determined as they arise.

3. The commission would recommend that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be:

- (a) Use for necessary domestic and sanitary purposes.
- (b) Service of locks used for navigation purposes.
- (c) The right to navigate.

4. The commission would also respectfully suggest that the treaty should prohibit the permanent diversion of navigable streams which cross the international boundary or which form a part thereof, except upon adjustment of the rights of all parties concerned by a permanent commission, and with its consent.

All of which is respectfully submitted,

GEO. C. GIBBONS,
Chairman, Canadian Section.

O. H. ERNST,
Brig.-Genl. U.S. Army, Retired,
Chairman, American Section.

W. F. KING,
Commissioner.

GEORGE CLINTON,
Commissioner.

LOUIS COSTE,
Commissioner.

E. E. HASKELL,
Commissioner.

Attest,

THOMAS COTE,
Secretary, Canadian Section.

Attest,

W. EDWARD WILSON,
Secretary, American Section.

APPENDIX 'A.'

To the Honourable

The Minister of Marine and Fisheries,
Dominion of Canada.

The memorial of the undersigned municipal corporations, persons and corporations respectfully sheweth :

That at the height of land in St. Louis and Lake Counties, in Northern Minnesota, the waters from Birch lake and White Iron lake, and the streams running out thereof, and the immense watershed thereof, run northward and ultimately into Rainy lake and from there into Rainy river, passing into the Lake of the Woods.

That the water from this source forms by computation seven per cent of the water passing out of Rainy lake over Alberton falls at Koochiching.

That the water system of Rainy lake, Rainy river and the Lake of the Woods have long been established as a commercial highway.

That from the Canadian ports of Rat Portage and Fort Frances, two large and well-equipped passenger and freight lines ply daily during the season of navigation, forming the means of water communication between the Canadian ports of Rat Portage, Rainy River town, Boucherville, Barwick, Emo, Big Forks, Little Forks, Isherwood, Fort Frances, Bears' Pass, Seine river and Mine Centre, and forming along a considerable part of such route the only vehicle of passenger and freight communication.

That the most important section of the 200 miles of navigation is the Rainy river, flowing through what is rapidly becoming a thickly-populated and prosperous valley for some eighty odd miles, with towns rapidly building up at close intervals on its banks, dependent almost wholly on the river route for their mercantile and manufacturing interests.

That the fine class of steamboats plying on this water is already, in certain portions of the summer, hampered by low water on the rapids and shoals of the river, and the proprietors of the regular steamboat lines have been earnestly petitioning for such improvement being made on the river as would remove such disability, a disability that compels the withdrawal for considerable intervals during each summer of some of the large and deeper draught steamboats.

That in view of the fact that navigation is already suffering for lack of adequate water in portions of Rainy river and in portions of Rainy lake, your memorialists are surprised and alarmed to learn that active steps are being taken by a corporation named the Minnesota Canal and Power Company, Duluth, Minnesota, to obtain the authorization of the Federal government of the United States, through the Commissioner of the General Land Office at Washington, to construct a dam or dams and canal to divert all the waters of the Birch lake and White Iron lake watershed hereinbefore referred to, into the Embarrass river, and by it into Lake Superior, thus diverting from and robbing this long-established international waterway of Rainy lake and river of the large proportion mentioned of its tributary waters.

That if permission is given by the Federal government of the United States to the project of the said Minnesota Canal and Power Company, a disastrous injustice will be done to Canada, and American established navigation companies that are using the water highway of Rainy lake and river, and to the manufacturing towns along the river, both on the Canadian and United States sides. And a most dangerous precedent will be established, the consequences of which can hardly be estimated if any attempt to interfere with or divert from their natural flow be permitted of any portion of the waters of the great watershed lying between the Lake Superior slope and the northern slope.

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Your memorialists would, therefore, most earnestly pray that the government of Canada should, in the interest of this important international navigation route, at once communicate with the Federal government of the United States and take prompt and active measures to avert the disastrous consequences of permission being unwittingly given by the General Lands Office at Washington to any scheme to interfere with or divert any portion of the waters tributary to the international waterways aforesaid.

(Sgd.) W. J. KEATING,
Mayor of Fort Frances.

(Sgd.) F. H. WARNER,
Clerk of Fort Frances.

Fort Frances, Ontario, March 17, 1904.

APPENDIX 'B.'

Whereas it has been reported that proposals have been made to divert from their present course certain lakes and streams in Northern Minnesota, which lakes and streams now form a part of the supply of waters of Rainy lake and river and the Lake of the Woods:

And whereas the diversion of these waters from their natural course is apt to cause a very material lowering of the waters of these lakes and river, thus entailing heavy losses to hydraulic power consumers, steamboat owners, and lumbermen who have invested their capital under existing conditions:

Therefore be it resolved that this municipal council of the town of Kenora do protest most emphatically against any interference with the natural flow of these waters, and that a copy of this resolution be forwarded to the Honourable Secretary of State for Canada, and to the Chief Engineer of the Deep Waterways Commission.

We hereby certify the foregoing to be a true copy of resolutions of the municipal council of the town of Kenora, adopted at meeting held July 4, 1906.

A. CARMICHAEL,
Mayor.

D. H. CUNIE,
Clerk.

APPENDIX 'C.'

RAINY RIVER NAVIGATION COMPANY, LIMITED.

KENORA, Ont., July 6, 1906.

J. G. SING,
Engineer in Charge, Dept. Public Works,
Toronto.

DEAR SIR,—Mr. Carmichael, our mayor, has informed me that you wished to know what effect the diverting of any water naturally feeding the Lake of the Woods would have on the business of our company. To this matter I have given a great deal of attention, and have followed the course of the water supply of Rainy river very carefully, and I am convinced that the water supply is not sufficiently great to allow of the diversion of any of the water without causing very serious loss to the transportation business. Of course, I am not an engineer and cannot give you any figures

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with reference to this matter, but I can tell you from long practical observation that it would be a great detriment to navigation, should any water be diverted, as there is none to spare. I trust that our government will object strenuously to any diversion of the head waters of the Lake of the Woods.

Yours truly,

GEO. A. GRAHAM,
Manager.

APPENDIX 'D.'

KENORA, CANADA, July 4, 1906.

EXTRACT FROM MINUTES OF THE MEETING OF THE BOARD OF TRADE OF THE DISTRICT OF RAINY RIVER.

Whereas it has been learned by this board that an application has been made by the Minnesota Canal and Power Company for privileges to divert water from the Birch lake draining basin, in the state of Minnesota, to Lake Superior.

And whereas this board is assured that such diversion of the said water will have a serious effect upon the navigation of Rainy lake and Rainy river, by rendering impossible the present means of transportation for boats and vessels now plying upon the said waters, with a resultant heavy but undeserved loss to the owners of same, and a heavy blow to the trade and commerce of the district adjacent to said waters, and to the people relying upon the same, not only for means of navigation, but for power for manufacturing purposes.

Now, therefore, be it resolved that this board do hereby protest most emphatically against the diversion of the said waters as aforesaid, and would urge that the present levels of the said waters, having been adapted to existing requirements of navigation and the creation of electrical power, should be maintained.

And that a copy of this resolution be forwarded to the Honourable the Minister of Public Works and the member of this electoral district.

J. P. EARNFLY, *President.*

J. DEAN, *Secretary.*

APPENDIX 'E.'

TORONTO, July 21, 1906.

To the Chairman and Members of the International Waterways Commission.

GENTLEMEN,—I have the honour, in accordance with directions received from your honourable body during your recent meeting in Buffalo, to submit the following statement regarding the application of the Minnesota Power and Canal Company to divert the flow of certain waters forming the boundary between the United States and Canada, adjoining the state of Minnesota and province of Ontario.

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I feel it would not be fair for any one to pass censure upon several of the technical arguments that have been advanced by the Minnesota Power and Canal Company in support of their application to divert waters from the drainage basin of Birch lake, unless any censure, so passed, was based upon exact knowledge resulting from special surveys and examinations of the territory likely to be affected by the diversion of said waters. Not possessing full data, resulting from such special surveys and examinations, I have considered it more profitable, for the purposes of your honourable commission, to express my views in the following manner :—

Permit me to make a few general remarks, and, first of all let me say, that deductions made from technical data and calculations, designed to exhibit the very small effects which the additions or subtractions of bodies of water may have upon the levels of certain other bodies of water in nature, are deductions which experience, in actual cases, has sometimes failed to substantiate.

As is well known, the changes our climate is manifesting, the denudation of timber lands, especially in localities such as the districts surrounding Rainy lake, Lake of the Woods and like influences, directly affect the run off from the watersheds; and the volume of water discharged from watersheds may, in time, become so changed as to materially, and disadvantageously affect the navigable properties of any waterways to which such watersheds contribute their supply.

When one appreciates the fact that a variation of a fraction of a foot in the depth of a waterway may be the factor which determines whether or not boats are able to navigate a certain channel, one can hardly be content to regard, without apprehension, the total removal of waters which are capable of rendering even small aid to navigation at times when that aid may be most necessary.

And, while it may be argued, that if waters are diverted from certain channels so that the levels in those channels are detrimentally affected, then other waters, elsewhere, may be reservoired so as to compensate for the effects of said diversion; nevertheless, one must consider whether or not it be wise to thus utilize stored waters to relieve an artificially created condition, when the future might possibly disclose a set of natural conditions that could only be relieved through the employment of these same systems of reservoirs.

It is a sense of the important bearing of the facts set forth in these remarks that cause me to say : that in my judgment, the absolute diversion, by the Minnesota Power and Canal Company, of the waters they desire, and which now contribute to the flow of waters in Rainy lake, and the Lake of the Woods and Rainy river, is a procedure which must disadvantageously affect the navigable properties of waterways which form a part of the international boundary between Canada and the United States.

In support of this opinion, I beg, respectfully, to submit the attached letters which express the views of parties whose interests are closely allied with the commercial navigation of some of these boundary waters.

It is apparent from these communications, that parties interested in the navigation of Rainy lake, Rainy river and the Lake of the Woods, view, with much apprehension, a proposal to divert waters, after the manner proposed in the application of the Minnesota Canal and Power Company.

There is, however, a phase of the discussion arising from the application of this company, which has appeared to me worthy of more serious and full consideration than, so far as I am aware, it has already had. That phase is the possible effect which the diversion of the waters of Birch lake drainage basin will have upon Basswood lake and the watercourses interconnecting it with Rainy lake.

It may be recalled that in addition to the water route from Lake Superior, westward, via the Grand Portage and the international boundary, there is the Canadian water route which has been traversed by many, and with troops and supplies, by the Red River expedition, in the early seventies.

Entering this Canadian route at Thunder bay, one proceeds, either by the old canoe route of the Hudson's Bay Company, or by the Dawson route to Lac des Mille Lacs,

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thence, onward via the chain of waters to the international boundary, joining the boundary at Lac la Croix. From Lac la Croix to Rainy lake water transportation, comparatively good for this territory, is met with.

Now, Basswood lake, which is capable of being navigated by small steamers, also forms part of the international boundary lying to the east of Lac la Croix, and the waters of Lac la Croix are largely contributed to by the flowage through, and from, Basswood lake, which lake in turn, is chiefly fed from the waters which flow into it from the Birch Lake drainage basin.

The question therefore arises, what effect will the diversion of these Birch lake waters have upon the levels in Basswood lake, in Lac la Croix, and in those other waters which constitute the highway of water transportation to Rainy lake, Rainy river, Lake of the Woods and on to Lake Winnipeg?

In the course of the discussions which have taken place with respect to the application of the Minnesota Canal and Power Company, the applicants have undertaken to show that the removal of the volume of water which they desire to divert from the waters which now contribute to the flowage along the international waterway, would have a comparatively small effect upon the levels of Rainy lake and the Lake of the Woods, owing, chiefly, to the large areas of the watershed and great storage capacities of these bodies of water.

While it may be true that the area of watershed, viz., 670 square miles, corresponding to the volume of water, viz., 600 cubic feet per second, proposed to be diverted by the Minnesota Canal and Power Company, is, according to the data supplied by this company's engineers, approximately only four per cent of the total area tributary to Rainy lake, and approximately only 2·3 per cent of the total area tributary to the Lake of the Woods, yet, this area of 670 square miles, corresponding to the proposed diversion, is approximately 37 per cent of the total area tributary to Basswood lake.

In the absence of data giving the annual ranges of water levels on Lac la Croix and Basswood lake, I am unable to indicate the amount of the changes in levels, which the proposed diversion of Birch lake waters would entail. It seems evident, however, that a diversion of the waters of the Birch Lake drainage basin to the extent just stated, of 37 per cent of the total area tributary to Basswood lake, would undoubtedly have an immediate and great effect upon the levels in Basswood lake, and this effect would probably be noticeable to navigators along the water courses connecting Basswood and Rainy lakes. In other words, it might be affirmed that part of a great system of waterways, of more or less navigable waters, would be detrimentally affected by diverting from their flowage the waters proposed to be diverted by the Minnesota Canal and Power Company.

Again, when we consider the vast energies and sums of money which have actually been spent, and which, annually, are being expended by nearly all countries upon their internal waterways and canals, and when we consider, also, the chain of waters connecting—through many portages it is true—Lake Superior with the west, it might be too hasty a conclusion for anyone to state, that for navigation purposes, these waters might not be much improved. If such improvement is ever to take place, might it not require all the water naturally shedding from the territory through which this great waterway passes? Capitalists are reported to have already proposed the canalization of the waters lying between Lake Superior and Lake Winnipeg. In the particular territory under discussion, railway traffic through Fort Frances and Kenora could be better regulated if the waterways, along the international boundary, were kept open for the best water communication they were able to afford.

Clearly, if enterprises, such as the Minnesota Canal and Power Company could obtain the right to divert waters from channels having present, and admitting of future, improved navigation, then through such precedent, much of the safeguard to the interests of navigation would be removed.

In conclusion, I may say that I find myself unable to report with favour upon an application such as has been made by the Minnesota Canal and Power Company, until such time as it would be demonstrated that the interests of navigation in future,

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would not be compromised by the removal of waters diverted after the manner in which the Minnesota Canal and Power Company propose to divert part of the waters which, naturally and materially, contribute to the flowage in the navigable channels of the international waterway between Canada and the United States.

In speaking of the canalization of the waters between Lake Superior and the Lake of the Woods, I find, upon reference to the report of the engineers who made the survey, that there are 311 miles of navigable waters between the summit near Lake Superior and the Lake of the Woods, and by the proper arrangement of a series of stop-log dams, and the construction of locks, these waters can be fully utilized for transportation purposes. The navigation, as proposed, would entail very little canal work, as the cutting would not amount to more than one mile in the entire distance of 311 miles.

In the development of this route, there is, under the present natural conditions, plenty of water, if conserved judiciously, for feeders, but it would not be safe to allow a diversion of any portion of the flow in an opposite direction to that intended by nature.

The total cost of opening up this route has been estimated at \$1,500,000, by the engineers who made the survey.

This waterway, if fully developed, would prove a safeguard against excessive rates being charged on any railway that might parallel it.

I have the honour to be, gentlemen,
Yours obediently,

J. G. SING,
Engineer in Charge.

THOMAS COTÉ, Esq.,
Secretary, Canadian Section
International Waterways Commission,
Toronto, Canada.

THIRD REPORT OF THE CANADIAN SECTION, 1906.

REPORT OF THE CANADIAN SECTION OF THE INTERNATIONAL WATERWAYS COMMISSION FOR 1906.

OTTAWA, CANADA, January, 1907.

The Honourable, the Minister of Public Works, of the Dominion of Canada:—

SIR,—The Canadian members of the International Waterways Commission have the honour to submit the following report, with regard to the work of the commission during the year 1906:

Re NIAGARA FALLS.

In our report of April 25, 1906, we made the following recommendations with regard to the diversions from Niagara river and on the Niagara peninsula:

(a) In the opinion of this commission it would be a sacrilege to destroy the scenic effect of Niagara falls, unless, and until the public needs are so imperative as to compel and justify the sacrifice.

(b) It is possible to preserve its beauty, yet permit the development on the Canadian side at the Niagara river itself and elsewhere by diversions on the Niagara peninsula to Lake Ontario, of water for power purposes to the extent of not more than 36,000 cubic feet per second, exclusive of water required for domestic uses, and for the service of locks in navigation canals.

(c.) It is likewise possible to allow the diversion of waters for power purposes on the American side to the extent of 18,500 cubic feet per second, exclusive of the amount required for domestic uses, without serious injury to the scenic aspect of the falls.

(d) Your commission are of opinion, therefore, that for the present the diversions should be limited to the quantities mentioned in sub-sections *b* and *c*.

(e) This would give an apparent advantage to the Canadian interests, but, as the diversion is not of serious injury to the falls and does not materially affect the interests of navigation, it is more than counterbalanced by the complete diversion of 10,000 cubic feet by way of the Chicago drainage canal to the Mississippi river.

Later on, the joint commission in the report of May 3, 1906, expressed the following views and recommendations:—

1. In the opinion of the commission, it would be a sacrilege to destroy the scenic effect of Niagara falls.

2. While the commission is not fully agreed as to the effect of diversions of water from Niagara falls, all are of the opinion that more than 36,000 cubic feet per second on the Canadian side of the Niagara river or on the Niagara peninsula, and 18,500 cubic feet per second on the American side of the Niagara river, including diversions for power purposes on the Erie canal, cannot be diverted without injury to Niagara falls as a whole.

3. The commission, therefore, recommends that such diversions, exclusive of water required for domestic use or the service of locks in navigation canals, be limited on the Canadian side to 36,000 cubic feet per second, and on the United States side to 18,500 cubic feet per second (and in addition thereto, a diversion for sanitary purposes not to exceed 10,000 cubic feet per second, be authorized for the Chicago drainage canal), and that a treaty or legislation be had, limiting these diversions to the quantities mentioned.

The effect of the diversion of water by the Chicago drainage canal upon the general navigation interests of the Great Lakes system will be considered in a separate report.

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The Canadian section, while assenting to the above conclusions, did so upon the understanding that in connection therewith should be expressed their view that any treaty or arrangement as to the preservation of Niagara falls, should be limited to a term of twenty-five years, and should also establish the principles applicable to all diversions or uses of waters adjacent to the international boundary, and of all streams which flow across the boundary.

The following principles are suggested:—

- 1. In all navigable waters the use for navigation purposes is of primary and paramount right. The Great Lakes system on the boundary between the United States and Canada, and finding its outlet by the St. Lawrence to the sea, should be maintained in its integrity.
 - 2. Permanent or complete diversions of navigable waters or their tributary streams, should only be permitted for domestic purposes and for the use of locks in navigation canals.
 - 3. Diversions can be permitted of a temporary character, where the water is taken and returned, when such diversions do not interfere in any way with the interests of navigation. In such cases each country is to have a right to diversion in equal quantities.
 - 4. No obstruction or diversion shall be permitted in or upon any navigable water crossing the boundary or in or from streams tributary thereto, which would injuriously affect navigation in either country.
 - 5. Each country shall have the right of diversion for irrigation or extraordinary purposes in equal quantities of the waters of non-navigable streams crossing the international boundary.
 - 6. A permanent joint commission can deal much more satisfactorily with the settlement of all disputes arising as to the application of these principles, and should be appointed.
- ‘The American members are of opinion that the enunciation of principles to govern the making of a general treaty is not within the scope of their functions; moreover the jurisdiction of the American members is restricted to the Great Lakes system.’

The quantity allowed to be diverted on the Canadian side was fixed at an amount, which, it was assumed, would allow the companies on that side to complete the works which they had under construction, as follows:—

	Cubic Feet.
Canadian Niagara Power Company..	9,500
Ontario Power Company..	12,000
Electrical Development Company..	11,200
Niagara Falls Park Railway Company..	1,500
Welland Canal, or its tenants (in addition to lock service)..	1,800
Total..	36,000

Producing about 425,000 horse-power. Amount allowed, 36,000 cubic feet.

On the American side the works in operation, or in course of construction, were as follows:—

	Cubic Feet.
Niagara Falls Hydraulic and Manufacturing Company.. . .	9,500
Niagara Falls Power Company..	8,600
Erie Canal, or its tenants (in addition to lock service).. . .	400
Total..	18,500

Amount allowed, 18,500 cubic feet.

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The matter was a subject of special legislation in the United States Congress, and what is known as the Burton Bill was passed and received the approval of the President in the following form:—

‘A bill for the control and regulation of the waters of Niagara river, for the preservation of Niagara falls, and for other purposes.’

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress, assembled.

That the diversion of water from Niagara river or its tributaries, in the state of New York, is hereby prohibited, except with the consent of the Secretary of War as hereinafter authorized in section two of this Act: Provided, That this prohibition shall not be interpreted as forbidding the diversion of the waters of the great lakes or of Niagara river for sanitary or domestic purposes, or for navigation, the amount of which may be fixed from time to time by the Congress of the United States or by the Secretary of War of the United States, under its direction.

Sec. 2. That the Secretary of War is hereby authorized to grant permits for the diversion of water in the United States from said Niagara river or its tributaries for the creation of power to individuals, companies or corporations which are now actually producing power from the waters of said river, or its tributaries, in the state of New York, or from the Erie canal; also permits for the transmission of power from the Dominion of Canada into the United States, to companies legally authorized therefor, both for diversion and transmission, as hereinafter stated, but permits for diversion shall be issued only to the individuals, companies or corporations as aforesaid, and only to the amount now actually in use: Provided, that the said secretary, subject to the provisions of section five of this Act, is hereby authorized to grant revocable permits, from time to time, to such individuals, companies or corporations, or their assigns, for the diversion of additional amounts of water from the said river or its tributaries to such amount, if any, as in connection with the amount diverted on the Canadian side, shall not injure or interfere with the navigable capacity of said river, or its integrity and proper volume as a boundary stream, or the scenic grandeur of Niagara falls; and that the quantity of electrical power which may, by permits, be allowed to be transmitted from the Dominion of Canada into the United States, shall be one hundred and sixty thousand horse-power: Provided further, that the said secretary, subject to the provisions of section five of this Act, may issue revocable permits for the transmission of electrical power so generated in Canada, but in no event shall the amount included in such permits, together with the said one hundred and sixty thousand horse-power, and the amount generated and used in Canada, exceed three hundred and fifty thousand horse-power: Provided always, that the provisions herein permitting diversions and fixing the aggregate horse-power herein permitted to be transmitted into the United States, as aforesaid, are intended as a limitation on the authority of the Secretary of War, and shall in no wise be construed as a direction to said secretary to issue permits, and the Secretary of War shall make regulations preventing or limiting the diversion of water and the admission of electrical power as herein stated; and the permits for the transmission of electrical power issued by the Secretary of War may specify the persons, companies or corporations by whom the same shall be transmitted, and the persons, companies or corporations to whom the same shall be delivered.

Sec. 3. That any person, company, or corporation diverting water from the said Niagara river or its tributaries or transmitting electrical power into the United States from Canada, except as herein stated, or violating any of the provisions of this Act, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding two thousand five hundred dollars nor less than five hundred dollars, or by imprisonment (in the case of a natural person), not exceeding one year, or by both such punishments, in the discretion of the court. And, further, the removal of any structures or parts of structures erected in violation of this Act, or any construction incidental to or used for such diversion of water or transmission of

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power as is herein prohibited, may be enforced by the order of any circuit court exercising jurisdiction in any district in which the same may be located, and proper proceedings, to this end, may be instituted under the direction of the Attorney-General of the United States.

Sec. 4. That the President of the United States is respectfully requested to open negotiations with the Government of Great Britain for the purpose of effectually providing, by suitable treaty with said government for such regulation and control of the waters of Niagara river and its tributaries, as will preserve the scenic grandeur of Niagara falls and of the rapids in said river.

Sec. 5. That the provisions of this Act shall remain in force for three years from and after date of its passage, at the expiration of which time all permits granted hereunder by the Secretary of War shall terminate, unless sooner revoked, and the Secretary of War is hereby authorized to revoke any or all permits granted by him by authority of this Act, and nothing herein contained shall be held to confirm, establish, or confer any rights heretofore claimed or exercised, in the diversion of water or the transmission of power.

Sec. 6. That for accomplishing the purposes detailed in this Act the sum of fifty thousand dollars, or so much thereof as may be necessary, is hereby appropriated from any moneys in the treasury not otherwise appropriated.

Sec. 7. That the right to alter, amend or repeal this Act is hereby expressly reserved.'

It will be seen that this bill is only a temporary measure, and intended to control conditions at Niagara, pending the negotiation of a treaty.

In the meantime application has been made by the Secretary of War of the United States for the privilege of exporting into the United States, power, as follows:

The Ontario Power Company....	90,000 h. p.
The Canadian Niagara Power Company..	125,000 h. p.
The Electrical Development Company..	62,000 h. p.

Final action has not as yet been taken. but in the meantime it has been recommended by the American section that permits be granted as follows:—

The Ontario Power Company....	60,000 h. p.
The Canadian Niagara Power Company..	60,000 h. p.
The Electrical Development Company ..	37,500 h. p.
The International Railway Company..	2,500 h. p.

In the opinion of your commission, if any treaty be had with relation to use of these waters, the proportions recommended and agreed upon by the joint commission should be adhered to.

The Ontario Power Company, through its ally, the Niagara Lockport and Ontario Company, has built transmission lines in New York State, in duplicate, and in branches, throughout a territory one hundred and fifty miles long and twenty miles wide at an expense of upwards of \$4,000,000, and for several months has been delivering power at the extreme end of the line.

This company has not so far made any serious effort to supply the Ontario market.

Mr. Paul K. Cravath, representing the Niagara Lockport and Ontario Power Company, in his address before the Secretary of War at Washington, stated that his company had entered into a contract with the Ontario Power Company to take from them a minimum of 60,000 horse-power at the international boundary line, and had reserved the option to take increased power to the amount of 180,000 horse-power, which would be the total capacity of the Ontario Power Company's works.

This company has neglected the city of Buffalo, leaving that market to the Canadian Niagara Power Company, and has extended its lines to Rochester and Syracuse. They are at present developing something under 60,000 horse-power, and it is stated by Mr. Cravath that they have already existing closed contracts for 90,000 horse-power, all on the American side.

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The Canadian Niagara Falls Power Company are in a position to develop at present about 55,000 horse-power, all of which will be supplied to customers in the neighbourhood of Niagara falls on the American side, and to the city of Buffalo and its contiguous outlying districts.

This corporation has not made any effort so far to supply the Canadian market.

The Electrical Development Company, which is more particularly a Canadian corporation, has built a transmission line to the city of Toronto. They have qualified themselves to produce about 50,000 horse-power in the immediate future.

This company is making strenuous efforts to have immediate permission to export to the United States, power to the extent of 53,000 horsepower.

In view of these conditions, and of the special advantages which will be created by a treaty arrangement, your commission would respectfully reiterate the views which they expressed in their report of the 25th of April, 1906, that your government, while fully recognizing the rights of these corporations, should so control the export of power from Canada as to protect public interests.

Your commission are of opinion that when each of the companies, in their agreement with the Park Commissioners, stipulated that they would, 'whenever required, from the electricity or pneumatic power, generated under this agreement, supply the same in Canada (to the extent of any quantity not less than one-half the quantity generated), at prices not to exceed the prices charged to cities, towns and consumers in the United States, at similar distances from the Falls of Niagara, for equal amounts of power and for similar uses.' They do not comply with the conditions of their agreement unless and until they have severally or jointly built transmission lines in Canada to an equal extent as in the United States.

Your commission is of opinion that it was of the spirit of the agreement if not the letter that the companies should themselves reach out to and supply the Canadian public, and that it is not a fair interpretation of the agreement that Canadian consumers should be expected to build transmission lines to Niagara falls as a condition of receiving any benefit from this public utility.

Irrespective of any agreement, private corporations using the natural resources of Canada, should, in the opinion of your commission, be compelled to operate the same, so as to afford adequate service in the first place to the Canadian public, and export of power at Niagara should only be allowed to the extent of the surplus after the Canadian market has been fully supplied under reasonable conditions and at fair prices.

THE DETROIT RIVER TUNNEL COMPANY.

The commission has considered the application of the Detroit River Tunnel Company for permission to tunnel the Detroit river. The regulations determined by the United States War Department were as follows :—

(a) That all operations shall be under the supervision and, so far as concerns the interests of navigation in the waters of the United States, under the control of the officer of the corps of engineers whose district includes the Detroit river; and who is hereinafter referred to as the district engineer. The Tunnel Company shall furnish such assistance and appliances as the district engineer shall require in supervising and inspecting the work.

(b) That the work of constructing the subaqueous portion of the tunnel shall begin at the American bank of the river, and proceed continuously toward the Canadian bank, in order that the working force may acquire experience and training at work where the water is shallowest and less used for navigation; thereby insuring the greatest rate of progress when operations approach the Canadian side and cross the path usually followed by vessels engaged in through traffic.

(c) That the Detroit River Tunnel Company may, in the prosecution of this work, use a pile platform of the general character described in its application, or, at its option, a floating platform of type to be approved by the district engineer. Whatever

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the character of platform used, its length, including all floating plant used in connection with it, shall at no time exceed 600 feet, measured transversely to the axis of the stream, and its width measured parallel to this axis, shall be not more than 300 feet.

(d) That due notification, in writing, shall be given to the district engineer of the beginning of dredging operations in the navigable waters of the United States, and that thereafter these dredging operations and the subsequent operations of tunnel extension and completion shall be pushed continuously, except when the river is obstructed by ice, and at a rate of not less than 2,000 cubic yards per day for the dredging, and ten feet per day of completed tunnel, the rate for the tunnel work to be figured from time to time of completion of the first section, 600 feet in length, of the erecting platform, floating or otherwise.

(e) That for the purpose of controlling and safeguarding navigation in the vicinity of the site of the proposed tunnel, the Detroit River Tunnel Company shall, at its own expense, furnish a fully-equipped tug of suitable size and power, to be constantly on duty at the site of the work, and, so far as the above purpose is concerned, under the exclusive control and direction of the district engineer. The Tunnel Company shall also maintain such lights as the district engineer shall require for properly marking every obstruction to navigation that may be introduced in connection with the work in progress.

These regulations were accepted with the approval of the Canadian Department of Marine and Fisheries, and the following resolution was adopted:—

‘That the International Waterways Commission approve of the plans of the construction of a tunnel under the Detroit river, prepared by the Detroit River Tunnel Company, and submitted to the commission by the Chief of Engineers of the United States Army, under date of February 13, 1906, and to the Minister of Marine and Fisheries for Canada, under date of November 16, 1905, the construction to be carried on on the American side under the regulations contained in the report of the Board of Engineers of the United States Army of date January 26, 1906, and that the same be carried on on the Canadian side under regulations to be fixed by the Minister of Public Works and the Minister of Marine and Fisheries.’

The plan and mode of construction having been submitted to the Minister of Public Works, were approved by the Governor General in Council on July 12, 1906, copy of the minutes are appended, marked ‘A.’

The tunnel is in course of construction, and it is expected will be completed within two years.

THE USES AND CONDITIONS OF THE WATERS OF ST. MARY’S RIVER AT SAULT STE. MARIE.

This question was disposed of by an unanimous report of the joint commission, dated May 3, 1906, in which the following recommendations were agreed upon:—

1. That no permits shall be granted for the use of the waters of St. Mary’s river, or for the erection of structures in, under or over, or the occupation in any manner of the said waters, until plans have been submitted to the commission for its investigation and recommendation; and the use of the waters under such permits, shall not be allowed, except upon compliance with the rules hereinafter recommended.

2. The commission further recommends that no grants, permits, or concessions should be made, which directly or by operation of law may, in any manner affect the right of the United States or of Canada to control the bed of the St. Mary’s river below high-water mark, and especially that none should be made which legally or equitably may be the means of adding to the expense of acquiring lands or rights for the purpose of making improvements in aid of navigation, or which may give an equitable right to compensation in case of the removal of structures in said river.

3. That steps be taken to increase the lockage facilities at the Sault Ste. Marie without unnecessary delay.

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4. That the Governments of the United States and Canada reserve all water necessary for navigation purposes, at present or in the future, and the surplus shall be divided equally between the two countries for power purposes.

5. As the Commission regards the interests of the United States and Canada in the preservation of the lake levels, and in the improvement of the channels and the conservation of the water supply for purposes of navigation as identical and as incapable of efficient protection without joint and harmonious action on the part of the two governments, it recommends that the rules hereinafter set forth be adopted, and that a joint commission be created to supervise their enforcement, or that such powers be vested in the existing International Waterways Commission, subject to such restrictions and reservations as may be deemed advisable.

The Secretary of War, in his annual report makes reference to these recommendations as follows:—

‘These recommendations received my approval. Embodied in the report were a series of rules and regulations to govern the use of water at the Sault. As the enforcement of these rules involves the creation of a permanent international commission, they have not, as yet, been put in force. It is to be presumed that provision for a permanent commission will be arranged in a treaty. The report was approved by me, and was referred to the Secretary of State.’

A letter from the Acting Secretary of State, to the Secretary of War, relating to the same subject, is hereto appended, and marked ‘B.’

THE MASSENA WATER POWER COMPANY.

This question was brought before the Commission by a letter from the Secretary of the Department of Public Works of Canada enclosing letter from the Calvin Company, Limited, to the Honourable the Minister of Public Works, protesting against construction of a dam, which is in contemplation by the Massena Power Company, in the channel of the St. Lawrence River, south of the Long Sault Island.

As the proposed works would be entirely in the United States territory, construction could not, in any case, be permitted without the concurrence of the War Department of the United States, but as no application had been made to that department or this commission, no action was thought necessary.

THE PRESERVATION OF THE CANADIAN SHORE ALONG THE DETROIT RIVER.

At the meeting, held by the commission on May 3, 1906, at Buffalo, N.Y., Mr. Louis Coste, one of the Canadian Commissioners, brought up the question of the injury done to the banks of the connecting channels of the Great Lakes by reason of the speed of the boats traversing those channels.

A petition from the reeve of the township of Malden, in the county of Essex, to the International Waterways Commission, copy of which is appended, marked ‘C.’ was presented to the commission. An investigation took place, and the commission decided that every effort should be made to assist the riparian owners in the protection of their property, and an appeal was made to the Engineer officer in charge of the improvements on the river, with the result that provision was made in a recent contract, under his charge, for protecting the Canadian shores by depositing boulders along that shore.

The Canadian section of the commission, in their investigation, reached the conclusion that the removal of large quantities of sand from the Canadian shore by sand suckers, is one of the causes of the cutting away of the bank, and they strongly recommend that steps be taken to prevent this practice.

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THE APPLICATION OF THE MINNESOTA CANAL AND POWER COMPANY.

The Minnesota Canal and Power Company, a corporation organized under the laws of Minnesota, proposed to construct reservoirs in the Birch Lake basin in Minnesota, and to conduct the water to be stored therein by artificial and natural channels southward to Duluth. The natural drainage of the Birch Lake basin is northward into the Rainy river, Lake of the Woods, Winnipeg lake, and finally into the Hudson bay, the water thus forming a part of the International boundary, and finally entering territory which is exclusively Canadian.

At the request of the British Ambassador, that action be deferred until the matter be investigated by the International Waterways Commission, the Department of the Interior suspended action, and the subject was finally referred to the commission in compliance with a request contained in a letter, dated May 14, 1906, from the Secretary of State to the Secretary of War. The commission rendered a joint report to the two governments, dated November 15, 1906, in which are the following recommendations, viz. :—

1. The commission would, therefore, recommend that the permit applied for be not granted without the concurrence of the Canadian government.

2. As questions involving the same principles and difficulties, liable to create friction, hostile feelings, and reprisals, are liable to arise between the two countries, affecting waters on or crossing the boundary line, the commission would recommend that a treaty be entered into which shall settle the rules and principles upon which all such questions may be peaceably and satisfactorily determined as they arise.

3. The commission would recommend that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be :

- (a) Use for necessary domestic and sanitary purposes.
- (b) Service of locks used for navigation purposes.
- (c) The right to navigate.

4. The commission would also respectfully suggest that the treaty should prohibit the permanent diversion of navigable streams which cross the international boundary or which form a part thereof, except upon adjustment of the rights of all parties concerned by a permanent commission, and with its consent.

The Secretary of War, in his report, says, 'I still have this matter under advisement, and expect to render my decision at an early date.'

THE CHICAGO DRAINAGE CANAL.

The diversion by the Chicago Drainage Canal of a large volume of water otherwise tributary to the Great Lakes system, has been in consideration by your commission, and a number of public meetings have been held at which the various interests have been represented.

The commission hope at an early date to be able to agree upon conclusions and recommendations in regard to this important subject, and submit the same in a special report.

THE APPLICATION OF MR. SMITH L. DAWLEY FOR PERMISSION TO DEVELOP POWER AT LONG

SAULT RAPIDS.

In May last, application (copy appended, marked 'D'), was made to the Secretary of War of the United States, by Mr. Smith L. Dawley, of Ogdensburg, for permission to construct dykes, retaining wall and such other structures as may be necessary for the development of a water power in connection with navigable approaches to a summer resort, on the United States side of the Long Sault rapids in the St. Lawrence river.

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The commission have been unable to obtain from the promoters the information necessary to enable them to form an opinion upon the effect which the granting of this charter would have upon navigation interests, and in the meantime action has been deferred.

THE QUESTION OF A TUNNEL AND INLET PIER FOR THE BUFFALO WATERWORKS.

At a meeting of the commission, held on June 26, 1906, at Buffalo, N.Y., Col. F. G. Ward, Commissioner of Public Works, of the city of Buffalo, appeared before the commission and stated that the proposed location of the inlet pier for the new waterworks tunnel for the city was in Canadian waters. He further stated that he had requested the American authorities to make application to the Canadian government to be authorized to erect the inlet pier in this location, copy of said application to the Governor General in Council and to the Minister of Public Works appended, marked 'E' and 'F' respectively.

Part of the proposed works being in Canadian waters, the matter was reported upon by Col. H. M. Adams, Corps of Engineers, United States Army, copy of said report appended, marked 'G.'

Application was also made by the city of Buffalo, to Honourable Wm. H. Taft, Secretary of War, copy of said application appended, marked 'H.'

The commission having satisfied themselves that the proposed undertaking would not interfere with navigation, passed the following resolution :—

Resolved, That in the opinion of the International Waterways Commission, the tunnel and inlet pier, proposed to be constructed in Lake Erie, by the city of Buffalo for the purpose of furnishing a pure water supply to the city, can be built without injury to navigation or other public interests, and it is recommended that permits for the construction of these works be granted with the proviso that the inlet pier be kept properly lighted at night at the expense of the city.

(Signed) GEO. C. GIBBONS,
Chairman, Canadian Section.

(Signed) O. H. ERNST,
Chairman, American Section.

Attest :

THOMAS COTÉ,
Sec. Canadian Section.

The Canadian government endorsed the above resolution by a minute of the Privy Council, dated July 20, 1906, copy of which is appended, marked 'I.'

NAVIGATION AND POWER DEVELOPMENT ON THE RICHELIEU RIVER.

An application (copy appended, marked 'J'), which was made by the International Development Company for permission to construct regulating works in Richelieu river in connection with a combined navigation and power project, was referred by the Secretary of War of the United States to the commission, by which it was considered at their meeting at Buffalo, November 13th and 15th.

The joint commission made a full report upon this subject, which has been submitted to both governments, from which the following is an extract :—

'As Lake Champlain is wholly within the territory of the United States, and the proposed works are wholly within Canadian territory, the international questions raised are of some moment. It is, in our opinion, not desirable that either nation should obstruct the natural flow of streams crossing the international boundary to the

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injury of public or private rights in the other. It is manifest, therefore, that the applicants should furnish conclusive evidence that private rights in the States of New York and Vermont, adjoining Lake Champlain, will not be injuriously affected by the alteration of the lake level as proposed, and that as the Secretary of War of the United States has control of the interests of navigation on Lake Champlain, the said work should not be undertaken without his permission, and should be operated under such regulations as he may direct, with a view to the maintenance of the level of the said lake, as the interests of navigation thereon require. It would be possible to plan works adapted to the conditions, and in our opinion such works should be permitted, provided they do not interfere with private interests in the United States, and meet with the approval of the Secretary of War, as suggested. We respectfully submit that in any treaty to be had between the two nations in relation to the use of international waters, the principles above suggested should have consideration. We would further suggest that the applicant's Canadian Act of incorporation should be amended so as to provide that the maintenance of the works sought to be erected shall be conditional at all times upon compliance with all regulations imposed by the Secretary of War of the United States of America, from time to time, for the preservation of the levels of Lake Champlain.

THE IRRIGATION QUESTION.

The question of the use of the waters of St. Mary's and Milk rivers, in the state of Montana, and the province of Alberta, was brought before the commission, but no action could be taken in the matter, since the American section did not consider that it lay within their powers to deal with the questions.

It may be of interest, however, to give here a brief statement of the salient points of the question. St. Mary's and Milk rivers both rise in Montana, a few miles south of the boundary line (49th parallel), the former in the Rocky mountains, the latter, farther east, from the eastern slopes of the foot-hills. Both rivers flow north into Canada, but Milk river, after a course of over one hundred miles, recrosses the boundary line and finally falls into the Missouri river.

On both sides of the boundary line, in the region which may be reached by irrigation canals, from these rivers, is a large tract of semi-arid country, of little use in its natural condition, but capable of vast development when a regular supply of water is assured. It is probable that the whole water supply of the two rivers might be put to beneficial use on either side of the boundary line. Of the two rivers, the St. Mary's is the more valuable for irrigation purposes, since it is the larger river in average flow, and also has a more constant supply, from the melting of snow at its mountain sources, during the hot months.

In the early days of irrigation in the Western States, the waters of streams were treated by riparian proprietors as property appertaining to their lands, which they could divert at will, without reference to the rights of other riparian owners. As the water used in irrigation is in great part, if not altogether, absorbed by growing vegetation, or dispersed by evaporation, little is returned to the river below, and the common law rights of the lower proprietors, to the natural flow through their lands, were impaired.

This was of little consequence when irrigating works were limited to the supply of a few cultivated acres, but when the advantages of irrigation came to be more fully recognized, and developments became more extensive, conflicts of interests multiplied, and the necessity of regulation of diversions by law became evident.

Laws for this purpose have been adopted by the several states in which irrigation is employed. These laws vary in different states, and it is not the intention here to discuss the details of the differences between different laws. The general principle behind them all is, however, the rights of the first diverter of water to his beneficial use; assertion of intention to divert is required by record in the registry office, by notice posted

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at the place of intended diversion, by newspaper advertisement, or the like. Difficulties arise, when there is no authority to apportion the water, from excessive appropriation by one owner to the detriment of the rest, and from the fact that records made against the same stream in different districts are not easily accessible; the intending irrigator has difficulty in ascertaining either what appropriations have been made which will lessen the flow to him, or those which have been made below him, and which he should respect.

It was the good fortune of Canada to be able to deal with these questions before they became complicated by vested private interests. In 1894 an Act of Parliament was passed by which the right of use of waters available for irrigation was vested in the Crown, and provision was made for apportionment of the waters, under regulations to be made by the Minister of the Interior. Surveys were made by the Dominion government to ascertain the most favourable locations for irrigation works, in order that the water might be used to the best advantage. Several irrigation projects have been developed under this policy, of which the Alberta Railway and Irrigation Company, whose canals connect with both the St. Mary's and the Milk river, is particularly concerned in the present question.

In 1901 an Act of Congress was passed having similar objects. Under this Act, a fund constituted by the sales of public lands in the west is to be used for the construction of irrigation works, where the same will be profitable. The administration of the fund is in the hands of the Reclamation Branch of the United States Geological Survey.

While the two laws are alike in establishing federal control of the use of water, they differ in that, under the American law the construction is carried on by public money, the cost being chargeable against the lands benefited. Under the Canadian Act construction is carried on by individuals or companies, but strictly under control of the government which controls the general plan of the works and prescribes the amount of water which may be diverted at a given place, the quantity which may be used for watering a given acreage, and the price which may be charged to the settler for it. The company is compensated for its work by an allowance on the price of the land sold.

The Alberta Railway and Irrigation Company, organized in 1898, has an extensive canal system supplied from St. Mary's river. They have also a canal by which water may be taken from Milk river, but this has not yet been put in operation.

One of the projects of the United States Reclamation Service is the diversion of water from St. Mary's river to irrigate land chiefly situated in the lower Milk river region. The canal for this purpose may either discharge into Milk river, whose natural channel would be utilized to carry the water through Canada to where it is to be used, or by a more southern route.

Fears have been expressed that this diversion may prejudicially affect the present settlements on the Alberta Railway and Irrigation Company's lands in Canada, or the future development, which may, in the natural course of things, be expected in that region, and the matter has been the subject from time to time of diplomatic exchanges between Ottawa and Washington, but no basis of agreement has yet been reached.

The Secretary of War, in his report for the past year, referring to the question of jurisdiction, says:

'Under the law of Congress creating the commission, its jurisdiction is limited to the waters whose natural outlet is by the River St. Lawrence to the Atlantic ocean. The Canadian government has, from the beginning, desired that the commission should consider all questions which may arise concerning the international waters from the Atlantic to the Pacific. To enable the American members to do this, further legislation by Congress is necessary. It would seem proper to comply with the wishes of the Canadian government in this respect.'

If the jurisdiction of this commission is extended as suggested, the matter can be taken up and no doubt some equitable plan of division of these waters can be suggested under the direction of the joint commission.

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THE LAKE ERIE BOUNDARY QUESTION.

On August 21, last, Captain Dunn, of the Canadian Fisheries cruiser *Vigilant* seized, as being in Canadian waters, certain nets, the property of the Keystone Fish Company, of Erie, Pa., which had been set in Lake Erie to the north-northwest of Erie. Copy of the departmental instructions under which Captain Dunn made the seizure is appended, marked 'K.'

It was claimed by the Keystone Fish Company that the nets were in American waters, and protest was made to the United States government against the action of Captain Dunn.

The condition seems to be complicated by differences in the charts as regards the position of the boundary line.

The question was referred to the International Waterways Commission to ascertain whether the American and Canadian charts of the locality agree as to the distance which should be logged from the gas buoys at Erie to the boundary line. The correspondence relating to the complaint of the Keystone Fish Company and the reference to the commission will be found appended, marked 'L.'

The subject is about to be dealt with in a special report of this commission which will be submitted in due course.

THE QUESTION OF CONTROLLING WORKS AT THE OUTLET OF LAKE ERIE.

This question, which was especially referred to the commission by the Act of Congress of 1902, will be taken up by the commission at an early date.

THE DEATH OF MR. GEORGE Y. WISNER.

Early in July, the commission lost one of its most distinguished members in the person of Mr. George Y. Wisner, hydraulic engineer of the city of Detroit, Mich. At a meeting held in Toronto on July 24, the appointment of Mr. E. E. Haskell, of Detroit, by the United States government was announced and the new commissioner presented. At that meeting it was moved by Mr. Gibbons, chairman of the Canadian section, seconded by Mr. Clinton and

Resolved, That the members of the International Waterways Commission have heard with profound regret of the decease of their colleague, George Y. Wisner, Esq., on July 3, at Detroit, Michigan. In the death of this eminent engineer the commission has lost an able adviser and valued associate. Upon the great experience and acquirements of Mr. Wisner the commission always felt it could rely; his fair-mindedness it has never doubted, and his devotion to his duties has ever assured the full and able performance of his duties as a commissioner. To his widow and family we extend our most sincere sympathy.

That this resolution be inscribed on the minutes and a copy be forwarded to Mrs. Wisner.

CONCLUSIONS.

It will be seen that the joint commission have made recommendations leading up to the formation of a treaty of the most important character, and one which will establish for the first time general principles governing the use and diversion of international and boundary waters.

1. The report with regard to the Minnesota diversion establishes the principle that there should be no permanent diversion of navigable streams which cross the international boundary or which form a part thereof, except upon adjustment of the rights of all parties concerned by a permanent commission and with its consent, save:

- (a) Use for necessary domestic and sanitary purposes.
- (b) Service of locks used for navigation purposes.
- (c) The right to navigate.

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2. The report on the Richelieu river application establishes the principle that neither country should allow any obstruction in the waters of streams which cross the international boundary which would interfere with the natural course of such waters to the injury of public or private rights in the other country.

3. Where temporary diversions of the surplus water can be permitted as at Sault Ste. Marie, such diversion should be permitted in like quantity to each country, under the supervision of a joint commission.

4. The position at Niagara falls has been dealt with having regard to the exceptional circumstances there existing and taking into consideration the large permanent diversion by way of the Chicago drainage canal.

5. Other important reports will be submitted in the near future, all leading up to the permanent settlement of questions, which unadjusted would be fruitful sources of irritation.

Your commission desire again, as in their former report, to acknowledge the fair spirit in which all the members of the American commission deal with international questions.

Respectfully submitted,

GEO. C. GIBBONS,
Chairman, Canadian Section.

W. F. KING,
Member, Canadian Section.

LOUIS COSTE,
Member, Canadian Section.

THOMAS COTE,
Secretary, Canadian Section.

APPENDIX 'A.'

EXTRACT from a report of the Committee of the Privy Council, approved by the Governor General on July 12, 1906.

On a report, dated June 29, 1906, from the Minister of Public Works, submitting that by the Act 51 Victoria, chapter 93 (1888), 'the Canada and Michigan Tunnel Company was incorporated, having powers thereby conferred for the building of a tunnel under the Detroit river for railway purposes, from some point at or near the town of Windsor or the town of Sandwich, towards the city of Detroit, and by the 35th section of this Act it was provided as follows:—

'35. The company shall not commence the said tunnel or any work thereto appertaining until it has submitted to the Governor in Council plans of such tunnel and of all the intended works thereunto appertaining, nor until such plans and the site of such tunnel have been approved by the Governor in Council, and such conditions as he thinks fit for the public good to impose; nor shall any such plan be altered, or any deviation therefrom allowed, except by the permission of the Governor in Council, and upon such conditions as he imposes.'

That by the Act 58-59 Victoria, chapter 71 (1895), the name of the company was changed to the 'Canada and Michigan Bridge and Tunnel Company,' and the undertaking of the company was declared to be a work for the general advantage of Canada.

That by the Act 4-5 Edward VII., chapter 69 (1905), the construction of the tunnel or tunnels authorized by the Acts relating to the company were to be commenced within three years and completed within ten years from the passing of the Act.

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That the company, pursuant to the powers contained in said firstly mentioned Act, amalgamated with the Michigan and Canada Bridge Tunnel Company, and formed a new corporation under the name of the 'Detroit River Tunnel Company,' and the agreement of amalgamation was duly filed in the office of the Secretary of State of Canada, on August 23, 1905, notice of the amalgamation, the location of the office in Canada, and the name of the corporation was duly published in the *Canada Gazette*.

The Minister states that on May 3, 1906, the Detroit River Tunnel Company has submitted for approval plans of the tunnel as proposed and of the site thereof, the said tunnel starting from a point in the city of Windsor towards the city of Detroit.

That similar plans for the construction of the said tunnel have been approved of by the Secretary of War for the United States, so far as the said tunnel is within the jurisdiction of the United States (copy of instrument dated April 9, 1906, is submitted, giving permission for the construction and maintenance of said tunnel).

That the Chief Engineer of the Department of Public Works has reported to the effect that the work is well located, that the site is acceptable, and that the general design for the construction is satisfactory.

The Minister, in view of the foregoing, recommends that authority be given for the approval of the plans of tunnel and of site above-mentioned, subject to the following conditions:--

That all operations shall be under the supervision and so far as concerns the interests of navigation in the waters of the Dominion of Canada, under the control of an officer to be appointed by the Department of Public Works, who is hereinafter referred to as the engineer in charge, the tunnel company shall furnish such assistance and appliances as said engineer in charge shall require in supervising and inspecting the work.

That said tunnel company may, in the prosecution of this work, use a pile platform of the general character described in its application, or, at its option, a floating platform of type to be approved by the said engineer in charge. Whatever the character of platform used, its length, including all floating plant used in connection with it, shall at no time exceed six hundred (600) feet, measured transversely to the axis of the stream, and its width measure parallel to this axis shall not be more than three hundred (300) feet.

That due notification, in writing, shall be given said engineer in charge of the beginning of dredging operations in the navigable waters of the Dominion of Canada, and that thereafter these dredging operations and the subsequent operations of tunnel extension and completion shall be pushed continuously, except when the river is obstructed by ice, and that the rate of not less than two thousand (2,000) cubic yards per day for the dredging, and ten (10) feet per day of completed tunnel, the rate for the tunnel work to be figured from the time of completion of the first section, six hundred (600) feet in length, of the erecting platform, floating or otherwise.

That for the purpose of controlling and safeguarding navigation in the vicinity of the site of the proposed tunnel, said tunnel company shall at its own expense, furnish a fully equipped tug of suitable size and power to be constantly on duty at the site of the work, and so far as the above purpose is concerned, either under the exclusive control and direction of the engineer in charge to be appointed by the Department of Public Works of Canada, or under the joint control of this engineer and the district engineer to be appointed by the government of the United States. Said tunnel company shall also maintain such lights as such engineer in charge shall require for properly marking every obstruction to navigation that may be introduced in connection with the working in progress.

That the engineer in charge appointed by the Department of Public Works of Canada will be given free access to each and every part of the work during its construction, whether such part or portion of the work be in the United States or Canadian waters.

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That consent be given to the taking possession by the company of so much of the public beach or lands covered with water or other property indicated on the said plans, as belongs to the Crown, and as may be necessary for the purpose of constructing and completing the said tunnel and for the convenient use of the same.

The committee submit the same for approval.

(Sgd.) JOHN J. McGEE,
Clerk of the Privy Council.

APPENDIX 'B.'

DEPARTMENT OF STATE, WASHINGTON,

July 17, 1906.

The Honourable

The Secretary of War.

SIR,—I have the honour to acknowledge the receipt of your report on the conditions existing at the Sault Ste. Marie, dated May 3, 1906, and signed by the American and Canadian members jointly of the International Waterways Commission organized in accordance with the provisions of section 4 of the River and Harbour Act, approved June 13, 1902, which report under date of May 14 last was endorsed with your approval so far as the War Department is concerned, and referred to the Secretary of State with a request that it be forwarded to the President as a basis for negotiations looking to the adoption of a treaty carrying into effect the recommendations of the commission.

As the proposed negotiations seem likely to involve the consideration of several of the other questions now pending before this commission, a preliminary list of which appears in the report of the American members of the commission, addressed to you on December 1, 1905, and printed as Appendix 'F' of your annual report for the year 1905, it probably would be advantageous to await the reports of the commissioners on these questions, if such reports may be expected, before initiating the negotiations on this question with the British Ambassador, in order that the whole subject may be dealt with comprehensively.

The considerations of these questions would naturally be associated with the proposed Niagara river negotiations, for which provision is made in the Act of Congress, approved on June 29, 1906. It will be observed that this Act fixed a limited period for carrying the negotiations on the Niagara river question to a conclusion. It is hoped, therefore, that any further recommendations from the commission, or the American members of the commission, with respect to these associated questions, which will require for their enforcement joint or concurrent action by the two governments under a treaty agreement, may be submitted by the commissioners as promptly as possible.

Inasmuch as the use of these waters is at present subject to War Department regulations, and apparently some of the recommendations of this report can be carried into effect on the American side of the boundary by executive action under existing laws, without treaty stipulations, it seems desirable that the report should be returned to you, pending the initiation of the proposed negotiations, in order that meanwhile the negotiations referred to may be adopted and enforced without waiting for concurrent action on the Canadian side, if that course seems desirable to you.

I therefore return herewith the original report, retaining a copy of it for the use of this department.

In transmitting this report, I desire to make a matter of record in connection with it, the fact that there is now pending an action brought by the United States against the Chandler-Dunbar Company, one of the power companies located on the American

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side of the Sault Ste. Marie, which involves some of the questions dealt with in this report, with respect to which the commissioners have stated their conclusions on the basis of the decision of the lower court in this case, which was against the contentions of the United States. I am advised by the Solicitor General of the United States, to whose attention this has been called, that an appeal is now pending from this decision, and if the United States succeeds on such an appeal and the decision is reversed, the conclusions of the commissioners based on the decision below, will require revision. This, however, I understand, relates only to the title to land under water and to certain lands on the American side of the boundary, and apparently does not diminish the value of the recommendations above referred to.

I have the honour to be, sir,
Your obedient servant,

(Sgd.) ROBERT BACON,
Acting Secretary.

APPENDIX 'C.'

To the Members of the International Waterways Commission.

GENTLEMEN,—The Reeve and Council of the township of Malden, in the county of Essex, province of Ontario, Canada, respectfully call your attention to the serious damage which the property of riparian owners and the township road, along the Detroit river, have suffered within the last five or six years.

Your petitioners believe that the enlargement and deepening of the waterway or channel made for the purposes of commerce, and the building and operating of larger and faster boats consequent thereto, has been the cause of the damage.

The township has been put to considerable expense in attempting to remedy the evil, and is unable to expend any more or cope properly with the trouble and protect the banks of the river, and the council humbly asks your honourable commission to investigate the matter, with the view of obtaining the necessary assistance from the two governments who have authorized the expenditure for deepening the river and bringing the larger boats nearer to the shore and throwing their swell and wash strongly against the banks.

On behalf of the council of the township of Malden,

(Sgd.) ROBERT ATKEN,
Reeve.

(Sgd.) JAMES HOMER,
Clerk.

APPENDIX 'D.'

To the Honourable W. H. TAFT,
Secretary of War, Washington, D.C.

Whereas there exists on Long Sault Island in the town of Massena, St. Lawrence county, New York, certain conditions favourable to the creation of an attractive summer resort, with navigable approaches thereto and the development of a water-power entirely in that portion of the St. Lawrence river that is within the United States.

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Therefore, application is hereby made to the Secretary of War for permission to construct dykes, retaining walls and such other structures as may be necessary, to carry out the above proposition. We refer to a marked chart of a section of the St. Lawrence river accompanying this application and which is part of the same. The dyke will begin at a point about 36 rods westerly from the east end of the above-named island and on the northerly side of same, and at a point in the shallow water about 300 feet out, or northerly from high-water mark on the shore of said island. Running thence easterly along said shore, keeping the wall out from same about the distance of 300 feet, northerly from the projecting points of the said island to a dam to be constructed at or near, but not beyond the point marked for it on the above-mentioned chart.

The wall at the starting point will rise not more than four feet above high-water mark and will extend level at same height to the dam. The above-mentioned dam shall be constructed with a spill-way or provision for overflow in case of high water. It is the opinion of competent engineers who have examined the proposition, that it will not in any way divert water from the channel, but will rather tend to throw more water into the channel and thus will be a benefit to navigation in that rather shallow portion of the St. Lawrence river.

Respectfully submitted,

(Sgd.) SMITH L. DAWLEY.

OGDENSBURG, N.Y., May 28, 1906.

APPENDIX 'E.'

BUFFALO, July 9, 1906.

To the Honourable
The Minister of Public Works,
Ottawa, Canada.

SIR,—The city of Buffalo desires to locate its new intake pier and tunnel in Lake Erie, a portion of which proposed location is in Canadian waters.

I have to-day made application to His Excellency, the Governor General of Canada, through the Honourable, the Secretary of State at Washington, D.C., for permission to locate this tunnel as shown on the accompanying maps. I inclose herewith, for your information, a copy of the application to the Governor General, and would respectfully request that you do what you can to expedite matters, so that the permission required may be obtained with the least possible delay.

Very respectfully yours,

(Sgd.) J. N. ADAM,
Mayor, City of Buffalo, N.Y.

APPENDIX 'F.'

CITY OF BUFFALO, MAYOR'S OFFICE,
July 9, 1906.

To His Excellency,
The Governor General of Canada.
Through the Honourable, the Secretary of State,
Washington, D.C.

SIR,—The city of Buffalo is situated at the foot of Lake Erie and along the upper waters of the Niagara river, as shown on the accompanying maps.

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It at present takes its water supply from an intake pier in the swift waters of the Niagara river, as shown on the map. This is objectionable, as the water is often more or less polluted, and the intake pier is an obstruction to the free navigation of the river.

For many years the city has been studying the best method of improving its water supply, and by the advice of eminent sanitary and hydraulic engineers, has adopted a scheme of improvement which consists in building a new pumping station near the foot of Porter avenue, and intake pier in Lake Erie, and a tunnel leading therefrom to the new and old pumping station.

In order to get the best water obtainable, it is desired to locate the intake pier where it will receive the water from the middle of the lake as it flows to the Niagara river, and unpolluted from either shore. The proposed location is shown in red on the accompanying published chart of Buffalo harbour and on a larger scale on the accompanying blue print. While on the published chart the boundary line between Canada and the United States is not shown, it is understood to lie in the south and east of the proposed pier location, thus leaving the pier and a portion of the tunnel in Canadian territory.

The city of Buffalo desires and asks permission from Canada to locate, build and maintain its intake pier and connecting tunnel in the location shown.

It is desired to state that the pier location is on the edge of the reef on which is located the Horse Shoe reef lighthouse, which was built and is maintained by the United States under arrangements made between the two countries. Attention is invited to the fact that the location is out of the ordinary tracks of vessels, which are shown on the published chart, and can be no obstruction to navigation.

The matter has been investigated by the United States engineer at this point, a copy of whose report to the effect that the pier would be no obstruction to navigation is inclosed.

Acting on the information thus obtained, the government of the United States, through the President and Congress, has passed an Act authorizing the city of Buffalo to build the pier and tunnel as proposed. A copy of this law is herewith inclosed.

The proposed intake pier is to be 110 feet in diameter, built of steel and concrete, and with a small wooden, stone-filled landing crib adjacent to it. The crib will be lighted at all times. The tunnel will be about 65 feet below mean lake level, so that it cannot interfere with navigation in the least.

In order that the work may proceed with the utmost rapidity, the city of Buffalo respectfully requests as early action as practicable on this, its formal request to Canada.

Very respectfully yours,

(Sgd.) J. N. ADAM,
Mayor, City of Buffalo, N.Y.

APPENDIX 'G.'

COPY of Report of Col. H. M. Adams, Corps of Engineers, on application of the city of Buffalo, New York, to construct a tunnel and inlet pier in Lake Erie.

U. S. ENGINEER'S OFFICE,
BUFFALO, N.Y., June 1, 1906.

Respectfully returned to the Chief of Engineers, U.S. Army.

An Act of Congress approved March 2, 1905, provides:

'That it shall be lawful for the city of Buffalo, in the state of New York, to construct and maintain a tunnel under Lake Erie, Niagara river, Black Rock harbour and the United States lands known as Fort Porter, extending from a point 200 yards

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more or less northeast of the Horse Shoe Reef light, in the Emerald channel, ten thousand feet to the present pumping station of the city of Buffalo, and to erect and maintain an inlet pier therefrom, said inlet pier to be located in the Emerald channel, not more than six hundred feet northeast of the present Horse Shoe Reef light: Provided, that the top of the said tunnel shall be located at least forty feet below mean lake level, and that the city of Buffalo shall maintain a light from sunset to sunrise on the inlet pier, at its own expense.

'The present application is for permission to construct a tunnel and inlet pier as authorized by the above Act, except that the inlet pier now proposed will be about one thousand feet southeasterly from Horse Shoe Reef light instead of "not more than six hundred feet northeast" of it. It is not believed that this change in location will injuriously affect navigation.

'The proposed inlet pier, and about one thousand seven hundred and fifty feet of the proposed tunnel will be in Canadian waters, as shown by maps of the Treaty of Ghent, establishing the international boundary line.

'The Horse Shoe Reef light is also on the Canadian side of the boundary, and on December 9, 1850, at a conference held at the British Foreign Office between Viscount Palmerson and Abbott Lawrence, Esq., the American Minister, it was agreed that England should cede to the United States "such portion of the Horse Shoe Reef as may be found requisite for the intended light-house, provided the government of the United States will engage to erect such light-house and to maintain a light thereon; and provided no fortification be erected on said reef."

A sketch map showing the locality and the boundary line is herewith inclosed.

H. M. ADAMS,
Colonel, Corps of Engineers.

APPENDIX 'H.'

DEPARTMENT OF PUBLIC WORKS,
BUFFALO, N.Y., May 24, 1906.

Hon. WILLIAM H. TAFT,
Secretary of War, Washington, D.C.

DEAR SIR,—The city of Buffalo, in the effort to improve its water supply, is desirous of having a new intake pier in Lake Erie, and a tunnel connecting it with a pumping station in the city.

The intake pier, it is proposed, shall be located at about the point indicated on the accompanying map and which point may be described as follows:

About 300 feet south of a line adjoining the main Breakwater light and the Horse Shoe Reef light, and about 1,000 feet from the latter light. The pumping station on shore would be near the foot of Porter Avenue, as shown on the accompanying map, and the tunnel would be practically on a straight line connecting the intake and pumping station, and with its top at least 30 feet below the bottom of the river, lake or improved channels, or practically 53 feet below mean lake level.

The intake pier would be circular in form and about 110 feet in diameter, with a small crib landing pier on its eastern side.

Your permission to build the proposed intake pier and tunnel is respectfully requested.

In asking your permission, it is respectfully represented to you that the location of the proposed intake is well away from any channel ordinarily travelled by lake or river boats, and will not be an obstruction to navigation. Attention is also invited

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to the fact that the proposed location is in the vicinity of the international boundary line between the United States and Canada. This line has never been marked on the ground, and it is impracticable to say whether the intake pier as proposed would be on the American or Canadian side of the line until the line is finally determined and marked through international action. As this determination and marking would undoubtedly take a long time, and as the need of the work of improving the water supply is urgent, it is respectfully requested that, in addition to granting your permission for the intake pier, you take the requisite and proper steps to secure the permission of Canada for the construction of the intake in advance of the final location and marking of the line.

The pier as proposed can work no possible harm to any navigation interests.

With your permission, it is desired that you insert any conditions which the city should fulfil in building and maintaining the pier and tunnel.

Respectfully yours,

(Sgd.) F. G. WARD,
Commissioner.

NOTE.—This letter confirms the plans filed by His Honour, the Mayor, with the Chief of Engineers on or about February 1, 1906.

APPENDIX 'I.'

EXTRACT from a Report of the Committee of the Privy Council approved by the Governor General on July 20, 1906.

On a memorandum, dated July 13, 1906, from the Minister of Public Works, submitting that by Act of Congress, dated June 28, 1906, the city of Buffalo, New York, is authorized to construct and maintain a tunnel under Lake Erie, Niagara river, Black Rock harbour, and the United States lands known as Fort Porter, extending from a point one thousand feet more or less, south-easterly of the Horse Shoe Reef light eleven thousand feet to the present pumping station of the city of Buffalo, and to erect and maintain an inlet pier therefrom, said inlet pier to be located not more than one thousand one hundred feet south-easterly of the present Horse Shoe Reef light, the top of the said tunnel to be located at least forty feet below mean lake level, the proposed works being for the purpose of supplying the city of Buffalo with pure water.

That, however, attention is drawn to the fact that the proposed location of these works is in the vicinity of the international boundary line between the United States and Canada. This line has never been marked on the ground and it is impracticable to say whether the intake pier as proposed would be on the United States or Canadian side until the line is finally determined and marked through international action. Application is therefore made to the Canadian government for permission to construct the said works.

The Minister states that the International Waterways Commission have examined into the matter. They state that the proposed tunnel and inlet pier can be built without injury to navigation, and they report favourable to the granting of the permission applied for.

The Minister, therefore, recommends that permission be given to the city of Buffalo to build the works above mentioned in Lake Erie, the location of which is shown on the plan hereto annexed, the said permission, however, to be revocable and subject to the following conditions : The top of the proposed tunnel shall be located at least forty feet below mean lake level, and the city of Buffalo shall maintain at its own expense a light on the said pier from sunset to sunrise.

The committee submit the same for approval.

(Sgd.) JOHN J. MCGEE,
Clerk of the Privy Council.

APPENDIX 'J.'

MEMORANDUM.

Application of Chas. W. Smith—Regulating Richelieu river.

For navigation and power purposes a continuous flow of not less than 9,000 cubic feet per second is desired in the Richelieu river. The average annual flow is greater than this, being 12,000 cubic feet per second. The low water discharge is 3,000 cubic feet per second and there are periods sometimes extending over six or eight months when the discharge is continuously less than 9,000. It is proposed to store up in Lake Champlain during the high water season enough of the surplus water to supply the deficiency during the low water season. For this purpose regulating works are to be constructed in the Richelieu river, by which the level of Lake Champlain will be maintained at a minimum of 97 feet above tide at New York, and it is stated that these works will not under any circumstances raise the high water level of Lake Champlain above 'the present high-water mark,' given as 101·5. Thus it is proposed to give the lake a range of 4·5 feet.

On page 324 of the 'Report of the Board of Engineers upon Deep Waterways between the Great Lakes and the Atlantic Tide Waters,' is a tabular statement of the monthly mean discharge of Lake Champlain for the years 1875 to 1898, inclusive. An examination of this table shows that the period which gave the lowest discharge, extended from September, 1882, to March, 1883; that which gave the next lowest extended from September, 1876, to March, 1877; that which gave the third lowest extended from September, 1883, to February, 1884; and that which gave the fourth lowest from August, 1894, to March, 1895. During these periods the amount flowing was less than 9,000 cubic feet per second, and in order to maintain that flow, it would have been necessary to draw from water previously stored for the purpose, the difference between 9,000 cubic feet and the amount which actually flowed.

The deficiencies for the first period were for

						Cubic feet.
September, 1882,	1,400	c. f. per second,	30	days....		3,628,800,000
October	"	1,800	"	31	"	4,821,120,000
November	"	3,500	"	30	"	9,072,000,000
December	"	4,600	"	31	"	12,320,640,000
January 1883,	5,000	"	"	31	"	13,392,000,000
February	"	4,000	"	28	"	9,676,800,000
March	"	2,200	"	31	"	5,892,480,000
						<hr/>
						58,803,840,000

The deficiencies for the second period were for

						Cubic feet.
September, 1876,	2,400	c. f.	per second,	30	days....	6,220,800,000
October	"	3,000	"	31	"	6,033,200,000
November	"	3,300	"	30	"	5,553,600,000
December	"	4,000	"	31	"	10,713,600,000
January, 1877,	4,100	"	"	31	"	10,981,440,000
February	"	3,800	"	28	"	9,192,960,000
March	"	700	"	31	"	1,874,880,000
						<hr/> 55,572,480,000

The deficiencies for the third period were for

						Cubic feet.
September, 1883,	2,700	c. f. per second,	30	days....		6,998,400,000
October	"	4,300	"	" 31 "		11,517,120,000
November	"	4,300	"	" 30 "		11,145,600,000
December	"	4,100	"	" 31 "		10,981,440,000
January, 1884,	3,700	"	"	31 "		9,910,080,000
February	"	300	"	" 28 "		725,760,000
						<hr/> 51,278,400,000

The deficiencies for the fourth period were for

						Cubic feet.
August, 1894,	2,100	c. f. per second,	31	days....		5,624,640,000
September	"	3,700	"	" 30 "		9,590,400,000
October	"	3,800	"	" 31 "		10,177,920,000
November	"	2,100	"	" 30 "		5,443,200,000
December	"	1,900	"	" 31 "		5,088,960,000
January, 1895,	1,200	"	"	31 "		3,214,080,000
February	"	1,600	"	" 28 "		3,670,720,000
March	"	1,400	"	" 31 "		3,749,760,000
						<hr/> 46,759,680,000

The area of Lake Champlain is 436·7 square miles, or 12,174,497,280 square feet. The depth required to store the deficiency during the first of the above periods is 4·81 feet; that for the second period is 4·56 feet; for the third period it is 4·21 feet, and for the fourth period it is 3·84 feet. Adding 1·25 feet for evaporation in eight months, those depths become 6·6, 5·81, 5·46 and 5·9 respectively. The range proposed, 4·5 feet, will, therefore, not be sufficient to provide 9,000 cubic feet per second throughout the low water season in very dry years.

A range much greater cannot be admitted without inflicting damage either upon the riparian owners or to navigation interests of Lake Champlain. In determining what is proper high water and what proper low water stage in this connection, it is not fair to take the extremes which the lake may have reached at long intervals in its history. A high water stage reached once in twenty years, for example, might inflict damage to property without destroying it, while if reached every year it might cause complete destruction, likewise the obstruction to navigation, caused by extreme low water stage, would be greatly multiplied, if repeated every year.

The table on page 323 of the report on Deep Waterways quoted above (gives the monthly mean stages of Lake Champlain from 1875 to 1898. The highest stage there recorded is 100·13 for the month of April, 1896. Upon only two other occasions did the stage reach 100. To raise the level above 100 regularly every year would be to inflict an injury upon riparian proprietors.

The mean elevation of the lake for the entire period was 96·10. The lowest stage reached was 93·65. During seven years it did not fall below 95. To allow the lake to be drained below 95 every year would be to inflict injury upon the navigation interests.

The limits between which the lake should be regulated are, therefore, 100 as a maximum and 95 as a minimum, notwithstanding that the reserve of water will not, in very dry years, be sufficient to supply 9,000 cubic feet per second.

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APPENDIX 'K.'

SPECIAL instructions to fishery officers, ex-officio magistrates in command of government steamers and vessels, engaged as Fisheries' police vessels in protecting the inshore fisheries of Canada.

OTTAWA, March 16, 1886.

SIR,—In the performance of the special and important service to which you have been appointed, you will be guided by the following confidential instructions:

For convenience of reference, these have been divided under the different headings of powers, jurisdiction, duties and general directions.

POWER.

The power with which you are invested is derived from, and to be exercised in accordance with the following statutes, among others, 'The Fisheries Act,' (31 Vic., cap. 60, of Canada), 'An Act respecting fishing by foreign vessels' (31 Vic., cap. 61, of Canada).

And the subsequent statute entitled, 'An Act to amend the Act respecting fishing by foreign vessels,' made and passed the 12th May, 1870 (33 Vic., cap. 15, of Canada; also an 'Act to further amend the said Act' (34 Vic., cap. 23, of Canada).

'Chapter 94 of the Revised Statutes (third series) of Nova Scotia' (of the Coast and Deep Sea Fisheries), amended by the Act entitled, 'An Act to amend Chapter 94, of the Revised Statutes of Nova Scotia' (29 Vic., cap. 35).

An Act passed by the Legislature of the Province of New Brunswick, entitled, 'An Act relating to the coast fisheries and for the prevention of illicit trade' (16 Vic., cap. 69).

Also an Act passed by the Legislature of Prince Edward Island (6 Vic., cap. 14) entitled, 'An Act relating to the fisheries and for the prevention of illicit trade in Prince Edward Island and the coasts and harbours thereof.'

Also from such regulations as have been passed or may be passed by the Governor General in Council, or from instructions from the Department of Fisheries, under 'The Fisheries Act,' hereinbefore recited.

As fishery officer you have full authority to compel the observance of the requirements of the Fisheries Acts and Regulations by foreign vessels and fishermen, in those parts of the coasts of Canada to which, by the convention of 1818, they are admitted to privileges of taking or drying and curing fish concurrent with those enjoyed by British fishing vessels and fishermen.

You will receive instructions from the Customs Department authorizing you to act as an officer of the Customs, and in that capacity you are to see that the revenue laws and regulations are duly observed.

JURISDICTION.

Your jurisdiction, with respect to any action you may take against foreign fishing vessels and citizens engaged in fishing is to be exercised only within the limits of 'three marine miles' of any of 'the coasts, bays, creeks or harbours' of Canada.

With regard to the Magdalen islands, although the liberty to land and dry and cure fish there is not expressly given by the terms of the convention to United States fishermen, it is not at present intended to exclude them from these islands.

DUTIES.

It will be your duty to protect the inshore fisheries of Canada in accordance with the conditions laid down by the convention of October 20, 1818, the first article of which provides:

‘Whereas differences have arisen respecting the liberty claimed by the United States, for the inhabitants thereof, to take, dry and cure fish, on certain coasts, bays, harbours and creeks of His Britannic Majesty’s dominions in America, it is agreed between the high contracting parties that the inhabitants of the said United States shall have, forever, in common with the subjects of His Britannic Majesty, the liberty to take fish of every kind, on that part of the southern coast of Newfoundland which extends from Cape Ray to the Rameau islands, on the western and northern coasts of Newfoundland, from the said Cape Ray to the Quirpon islands, on the shores of the Magdalen islands, and also on the coasts, bays, harbours, and creeks from Mount Joly, on the southern coast of Labrador, to and through the Straits of Belle Isle, and thence northwardly indefinitely along the coast, without prejudice, however, to any of the exclusive rights of the Hudson’s Bay Company; and that the American fishermen shall also have liberty, forever, to dry and cure fish in any of the unsettled bays, harbours and creeks, of the southern part of the coast of Newfoundland, hereabove described, and of the coast of Labrador; but as soon as the same, or any portion thereof, shall be settled, it shall not be lawful for the said fishermen to dry or cure fish at such portion so settled, without previous agreement for such purpose with the inhabitants, proprietors, or possessors of the ground.

‘And the United States hereby renounces forever any liberty heretofore enjoyed or claimed by the inhabitants thereof, to take, dry or cure fish on or within three marine miles of any of the coasts, bays, creeks or harbours of His Britannic Majesty’s dominions in America, not included within the above mentioned limits; provided, however, that the American fishermen shall be permitted to enter such bays, or harbours, for the purpose of shelter and repairing of damage therein, of purchasing wood and of obtaining water, and for no other purpose whatever. But they shall be under such restrictions as may be necessary to prevent their taking or curing fish therein, or in any other manner whatever abusing the privileges hereby reserved to them.

By this you will observe, United States fishermen are secured the liberty of taking fish on the southern coasts of Labrador, and around Magdalen islands and of drying and curing fish along certain of the southern shores of Labrador, where the coast is unsettled, or if settled, after previous agreement with the settlers or owners of the ground.

In all other parts the exclusion of foreign vessels and boats is absolute, so far as fishing is concerned, and is to be enforced within the limits laid down by the convention of 1818, they being allowed to enter bays and harbours for four purposes only, viz.: for shelter, the repairing of damage, the purchasing of wood, and to obtain water.

You are to compel, if necessary, the maintenance of peace and good order by foreign fishermen pursuing their calling and enjoying concurrent privileges of fishing or curing fish with British fishermen, in those parts to which they are admitted by the treaty of 1818.

You are to see that they obey the laws of the country; that they do not molest British fishermen in the pursuit of their calling, and that they observe the regulations of the fishery laws in every respect.

You are to prevent foreign fishing boats and vessels which enter bays and harbours for the four legal purposes above mentioned, from taking advantages thereof, to take, dry or cure fish therein, to purchase bait, ice or supplies, or to tranship cargoes, or from transacting any business in connection with their fishing operations.

It is not desired that you should put a narrow construction on the term ‘unsettled.’ Places containing a few isolated houses might not, in some instances, be susceptible of being considered as ‘settled’ within the meaning and purpose of the Convention. Something would, however, depend upon the facts of the situation and circumstances of the settlement. Private and proprietary rights form an element in

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the consideration of this point. The generally conciliatory spirit in which it is desirable that you should carry out these instructions, and the wish of Her Majesty's Government that the right of exclusion should not be strained, must influence you in making as fair and liberal an application of the term as shall consist with the just claims of all parties.

Should interference with the pursuits of British fishermen or the property of Canadians appear to be inseparable from the exercise of such indulgence, you will withhold it, and insist upon entire exclusion.

United States fishermen should be made aware that, in addition to being obliged, in common with the subjects of Her Majesty, with whom they exercise concurrent privileges of fishing in Colonial waters, to obey the laws of the country, and particularly such Acts and Regulations as exist to ensure the peaceable and profitable enjoyment of the fisheries by all persons entitled thereto, they are peculiarly bound to preserve peace and order in the quasi settled places to which, by the liberal disposition of Canadian authorities, they may be admitted.

Wheresoever foreigners may fish in Canadian waters, you will compel them to observe the Fishery Laws. Particular attention should be directed to the injury, which results from cleaning fish on board their vessels, while afloat, and the throwing overboard of offals, thus fouling the fishing, feeding and breeding grounds. 'The Fisheries Act' (Section 14) provides a heavy penalty for this offence.

Take occasion to inquire into and report upon any modes of fishing, or any practices adopted by foreign fishermen, which appear to be injurious to the fisheries.

GENERAL DIRECTIONS.

You will accost every foreign fishing vessel, within the limits described, and if that vessel should be either fishing, preparing to fish, or should obviously have been fishing within the prohibited limits, you will, by virtue of the authority conferred upon you by your commission, and under the provision of the Acts above recited, seize at once (resort to force in doing so being only justifiable after every effort has failed), any vessel detected in violating the laws, and send her, or take her, into port for condemnation.

Copies of the Acts of Parliament subjecting to seizure and forfeiture any foreign ship, vessel or boat which should be either fishing, preparing to fish or should obviously have been fishing within the prohibited limits, and providing for carrying out the seizure and forfeiture are furnished herewith for your information and distribution.

Should you have the occasion to compel any foreign fishing vessel or fishermen to conform to the requirements of the 'Fisheries Act and Regulations,' as regards the modes and incidents of fishing, at those places to which they are admitted under the Convention of 1818, particularly in relation to ballast, fish offals, setting of nets, hauling of seines, and use of 'trawls' or 'bultows' more especially at and around the Magdalen Islands, your power and authority, under such cases, will be similar to that of any other fishery officer appointed to enforce the Fishery Laws in Canadian waters (Vide Fisheries Act).

If a foreign ship, vessel or boat be found violating the convention or resisting consequent seizure and momentarily effects her escape from the vicinity of her capture or elsewhere, she remains always liable to seizure and detention, if met by yourself in Canadian waters, and in British waters everywhere, if brought to account by Her Majesty's cruisers. But great care must be taken to make certain of the identity of any offending vessel to be so dealt with.

All vessels seized, must be placed, as soon as possible, in the custody of the nearest custom collector, and information, with a statement of the facts and the deposition of your sailing master, clerk, lieutenant, or mate, and of two at least of the most reliable of your crew, be dispatched, with all possible diligence to the government. Be careful

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to describe the exact locality where the violation of the law took place, and the ship, vessel or boat was seized. Also corroborate the bearings taken, by soundings, and by buoying the place (if possible), with a view to actual measurement, and make such incidental reference to conspicuous points and land marks as shall place beyond doubt the illegal position of the seized ship, vessel or boat.

Omit no precaution to establish, on the spot that the trespass was or is being committed, within three miles of land.

As it is possible that foreign fishing craft may be driven into Canadian waters by violent or contrary winds, by strong tides, through misadventure, or some other cause independent of the will of the master and crew, you will consider these circumstances, and satisfy yourself with regard thereto before taking extreme step of seizing or detaining any vessel.

On capture, it will be desirable to take part of the foreign crew aboard the vessel under your command, and place some of your own crew, as a measure of precaution, on board the seized vessel; first lowering the foreign flag borne at the time of capture. If your ordinary complement of men does not admit of this being done, or if, because of several seizures, the number of your hands might be too much reduced, you will, in such emergency, endeavour to engage a few trustworthy men. The portion of the foreign crew taken on board the government vessel you will land at the nearest place where a consul of the United States is situated, or where the readiest conveyance to any American consulate in Canada may be reached, and leave them there.

When any of Her Majesty's vessels about the fishing stations or in port are met with, you should, if circumstances permit, go on board and confer with the naval commander, and receive any suggestions he may feel disposed to give, which do not conflict with these instructions, and afford him any information you may possess about the movements of foreign craft; also inform him what vessels you have accosted and where.

Do not fail to make a full entry of all circumstances connected with foreign fishing vessels, noting their names, tonnage, ownership, crew, port, place of fishing, cargo, voyage, and destination, and (if ascertainable), their catch. Report your proceedings as often as possible, and keep the department fully advised on every opportunity, where instructions would most probably reach you at stated intervals.

Direction as to the stations and limits on which you are to cruise, and any further instructions that may be deemed necessary, will from time to time, be conveyed to you.

Considerable inconvenience is caused by Canadian fishing vessels neglecting to show their colours. You will draw the attention of masters to this fact, and request them to hoist their colours without requiring to be hailed and boarded.

It cannot be too strongly urged upon you, nor can you too earnestly impress upon the officers and crew under your command, that the service in which you and they are engaged should be performed with forbearance and discrimination.

The government relies on your prudence, discretion and firmness in the performance of the special duties entrusted to you.

I am, sir, your obedient servant,

(Signed) GEORGE E. FOSTER,

Minister of Marine and Fisheries.

DEPARTMENT OF MARINE AND FISHERIES,

OTTAWA, October 27, 1894.

SIR,—You are hereby instructed to proceed, without delay, to Amherstburg, and take up your station at the western end of Lake Erie. It is reported to the department that United States fishing tugs from Erie, Cleveland, Sandusky and Toledo, are in the habit of following the whitefish and herring, which at this season, are moving to their spawning grounds among the islands at the western end of the lake and in Detroit river.

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Among the islands there can be no doubt about the exact position of the boundary line, so that you can then have no difficulty in deciding whether fishing is carried on by foreign vessels or boats in Canadian waters.

In the event of seizure being made, you will establish exactly the position of the seizure by cross bearings, if necessary you should also buoy the position of the seizure, so that you can accurately fix the position, after having made the seizure, by direct measurements, from the shore. You will note and report to the department the extent to which fishing is carried on during the fall season and the spawning grounds in the United States waters at the head of Lake Erie.

I am, sir, your obedient servant,

(Signed) JOHN HARDIE,
For Deputy Minister of Marine and Fisheries.

Captain E. DUNN,

Petrel,

Care of T. H. ELLIOTT,

Sault Ste. Marie, Ont.

DEPARTMENT OF MARINE AND FISHERIES,

OTTAWA, March 27, 1894.

SIR,—I have to instruct you to commission the *Petrel* on the 15th of April or immediately navigation opens. You are to cruise round Pelee and the Canadian island for the purpose of seizing American gill nets if set. Grapnels are to be used, if necessary, and they are to be constructed as follows: A piece of iron 3 feet long, $\frac{3}{4}$ of an inch thick, with a hole punched 4 inches from point and a line attached. You are always to harbour, if possible, in a Canadian port. After remaining around the island until about the 1st of May, then proceed to Point Pelee, and keep a sharp lookout for our own fishermen fishing gill nets without a license, from thence to Rondeau bay, when the open waters of the bay should be searched for gill nets, returning to Pelee island about the 15th of May, remaining in this vicinity till the beginning of June; this is considered a very important season, as a good many American vessels come over to catch bass during the close season.

The *Petrel* should then return to Lake Huron until about the 20th June, remaining there as long as necessary, and come back to Lake Erie and cruise in front of Point Pelee, Port Stanley, Bruce and Port Burwell, where American nets are reported to fish gill nets at this time of the year in deep waters from 6 to 12 miles from the Canadian shore. She should cruise round these points till the middle of July, then proceed to Georgian Bay, to look after the salmon trout and whitefish fisheries. At the beginning of September you will have to return to look after bass fishing in the neighbourhood of the Canadian islands off and on until the end of the season. You will then have to take particular care with regard to encroachments by foreign fishermen, and also with regard to fishing during close season for whitefish.

Outside these instructions you will use your own discretion as to the best means of protecting the fisheries.

The commander of the Fisheries Protection Service has been requested to send you a supply of rifles and cutlasses. You will purchase the ammunition at the best and cheapest place. Commander Spain has also been told to send you the general instructions as regards drill, discipline, &c., which are carried on board the other vessels of the fleet under his command. The *Petrel* will be inspected at irregular intervals by the commander of the Protection Service.

I am, sir, your obedient servant,

(Signed) JOHN HARDIE,
For Deputy Minister of Marine and Fisheries.

Captain DUNN,

Owen Sound, Ont.

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DEPARTMENT OF MARINE AND FISHERIES,

OTTAWA, October 26, 1893.

SIR,—Adverting to the general instructions given you on the 8th ultimo, I am to direct you to prevent poaching by United States tugs and boats in Canadian waters, a practice which this department has reason to believe is extensively carried on in Lake Huron, especially between Point Edward and Point Clarke, and in the neighbourhood of Detroit. All nets which you may find set on the Canadian side of the boundary, belonging to foreigners, should be seized and confiscated, and the fact immediately reported to the department, with full details as to the time and place of seizure, the number and length of nets, &c.

I inclose, for your information and guidance, copy of the statute relative to fishing by foreign vessels.

You will accost every United States vessel or boat which you may notice in Canadian waters, and if either fishing, preparing to fish or having obviously fished within the exclusive limits, you will, in accordance with the above statute, seize at once any such vessel or boat detected in violating the law, and immediately place her under the charge of the nearest Collector of customs for safe keeping ; pending action by this department. Then you are to send, at once, full information of such seizure, with a statement of the fact and the deposition of the captain and one or two of the most reliable and intelligent of the crew. Be careful to describe the exact locality where the unlawful fishing took place, and the vessel or boat seized. Corroborate the bearings taken by soundings and by reference to conspicuous points and land marks, as shall place, beyond doubt, the illegal position of the illegal vessel or boat. In fine, you should omit no reasonable endeavour to establish beyond dispute that the illegal fishing was in Canadian waters.

The department relies upon your prudence to carry out the above directions, with firmness and discretion.

Inquire as you go along, about the manner in which each overseer attends to his work, and report at once any one who may be neglectful or inattentive to his duties.

You will undoubtedly, in the course of your cruise, be able to collect valuable information as regards the present state of the fisheries on each side of Lake Huron, the principal breeding grounds of whitefish, salmon trout and herring ; on the places which require the greatest amount of protection, in fact on all matters looking to an improved and more efficient system of protection for these waters. This information should be carefully noted down with facts and data in support, for the purpose of being embodied in a general report which you will make at the end of your cruise.

State when you will be ready to sail on your cruise.

I am, sir, your obedient servant,

(Signed) WM. SMITH,

Deputy Minister of Marine and Fisheries.

Captain E. DUNN,

Owen Sound, Ont.

DEPARTMENT OF MARINE AND FISHERIES,

OTTAWA, September 8, 1893.

SIR,—The Minister having decided to give you another trial as fishery officer in command of the Government Cruiser *Petrel*, I have been directed to prepare the following instructions for your guidance :—

1. Until further orders, you will pay particular attention to the protection of fish and to the enforcement of the fishery laws and regulations in the waters of Lake Huron and Georgian bay. Should it be found advisable at any time to extend the field of your action, you will be accordingly instructed.

2. You are already familiar with the Fishery Laws and Regulations, applicable to the waters under your charge. Within these limits, you will, when necessary, exer-

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cise magisterial functions, as provided by section 2, chap. 95, Revised Statutes of Canada.

The various Fishery Officers within these limits (a schedule of which is herewith attached), will be under your immediate directions, as well as to the general and special instructions from this department which may be furnished to you and to them from time to time. You will see that they attend to their work, and report any failure on their part to do so.

3. The duties of your office relate chiefly to the enforcement of the Fishery Laws and Regulations. Copies are herewith, for your information, as well as copies of the latest departmental reports. Particular attention should be given to the following points :—

(a) The constant inspection and actual examination into the actual conditions of the fisheries within your district;

(b) Their produce and destruction, the men, material, tonnage, etc., engaged in them, the details of the fishing industry as an important branch of the country's commerce;

(c) You are to ascertain whether abusive practices prevail, and to suggest remedies and improvements of existing regulations, which may be in your opinion needed ;

(d) Mill dams or other obstructions on rivers should be reported upon, with a view to rendering them passable for fish;

(e) You are to strictly enforce the Statutes respecting sawdust and mill rubbish whenever you find the law violated or complaints are made to you.

4. An important part of your duty consists of prosecution 'on view,' as provided by section 17 of the statute, or upon the information of the local officers or others, of all offenders against any of the fishery laws or regulations. It is, therefore, desirable to give you some instructions on this head.

You will be careful to advise officers in your district to engage in no litigation, but to report to you in case of necessity, when you will at once conduct such matters to a conclusion. Convicting persons 'on view' without any form of process is improper. Power to a magistrate to convict on his own view is, in the main, a summary way of dispensing with all other testimony, except that of the convicting justice. It does not do away with the necessity of a summons, either oral or in writing, neither does it preclude defense. Each case must be duly recorded and a regular conviction afterwards formulated, stating that it is 'on view' had of the offence, that a conviction is made. You may cite the offender by oral command, or by summons in writing, after hearing his plea or defence, and after considering any extenuating circumstances if such there be, and such as are admissible in mitigation of the penalty, proceed forthwith, in the presence of the defendant, to impose a fine, etc., with the alternative of imprisonment. In such cases no complaint is necessary. No part of the penalty accrues to the convicting officer, the whole belongs to the Crown.

The penalty provided by section 18 of the Fisheries Act for each offence varies from \$1 to \$20, in the discretion of the convicting officer or magistrate. The department favours the imposition of the highest penalty, because, as a rule, small fines do very little good.

All materials, implements or appliances used in contravention of the Fisheries Act, or the regulations made under it, are liable to confiscation in addition to the penalty imposed.

5. The mode of rendering your monthly accounts is fully explained in the circular herewith, and the blank forms supplied for your use. In connection with this matter, the Minister desires to impress upon you the necessity of being as economical as possible in your expenses, always keeping the efficiency of the service in view. You will keep a full and complete diary of every day's work, in which you will note down not only the name and address of every one to whom you pay money, but the purpose for which such money was expended; the reasons for every journey; the results of each visit, &c.

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6. As early as possible after the 1st of December, you will furnish this department with a full and detailed report of your operations and the state of the fisheries within the district under your charge. You will append to this report full returns of the yield of the fisheries of the whole division, for which purpose blank forms will be sent you.

7. The principal part of your division where illegal fishing is known to be most prevalent, is on the north-eastern coast of Georgian Bay, between Moon River and Byng Inlet. This part of the coast is under charge of Overseer Jackson, of Midland Harbour. On your first visit to that part of the coast, you will take him with you, his intimate knowledge of the localities and of the fisheries will be of great advantage to you.

8. A good deal of illegal fishing is also carried on near the mouth of French river, around the Bustard islands; at Badgley island, near Wikivemikong, and at Little Current. These places are under charge of Overseer Elliott, of Sault Ste. Marie, with whom you will arrange to accompany you when you visit these localities.

9. The department has also reason to believe that a good deal of illegal fishing takes place every fall at the Fishing islands, Lake Huron, as well as at other places in that neighbourhood, along the coast of the county of Bruce.

In this connection you will see that no seine hauling is done at Sauble beach.

10. Instruct the several officers on Georgian bay to keep a sharp lookout for freezers and shipping of fish during the close season. The department has reason to believe that a great many evasions and violations of the law occur through neglect of fishery officers on this head; especially at Collingwood, where Overseer Donaldson is located. You will direct him to maintain a strict watch over the Nottawasaga river and see that no illegal fishing is carried on there.

11. You are personally acquainted, it is presumed, with Overseer Elliott, and the extent of his work. It is, therefore, unnecessary to give you any special directions on this head. It will be well, however, to remind you to keep in constant communication with him, so as to advise him of any illegal fishing which may take place in the most distant parts of his division, that is to say, Spanish and French rivers, and around the south and southeastern shores of Manitoulin island. In the latter connection, you will keep an eye on Mutchmore's mill, at Providence Bay, and see that the law relative to sawdust is strictly carried out.

12. The close season for whitefish and salmon trout will as usual be from 1st to 30th November, both days inclusive. All the licenses issued this year for fishing in the waters of Lake Huron and Georgian bay expire on October 31. All gill-nets or pound nets which you may find in the water after October 31 should be destroyed, the fish confiscated and sold and the parties prosecuted.

13. Keep the department regularly and fully advised of your movements. Telegraph only on matters of importance. Mail facilities are sufficiently prompt for the general requirements of the service.

14. When you require advice, communicate with the department, giving a full statement of facts involved.

Let every matter in your correspondence form the subject of a separate letter. This obviates confusion and assures prompt attention.

All your official communications should be addressed to the Deputy Minister of Marine and Fisheries.

A supply of stationery is herewith for official use.

I am, sir, your obedient servant,

(Sgd.) JOHN HARDIE,

For Deputy Minister of Marine and Fisheries.

Captain E. DUNN,
Owen Sound.

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DEPARTMENT OF MARINE AND FISHERIES,
OTTAWA, September 10, 1890.

SIR,—I have the honour to inform you of your appointment by His Excellency the Governor General in Council, to the command of the government steam yacht, *Cruiser*, and as a fishery officer for the Great Lakes and Georgian bay, with magisterial jurisdiction under the Fisheries Act on these waters and vicinity.

The forms of oath of office, which are herewith, you will be good enough to attest to, before a justice of the peace, and return them to the Fisheries Department at your earliest convenience. I also inclose for your information and guidance, copies of the Fisheries Act and Regulations (the latter having equal power with the Act itself). It is desirable that you should, without delay, make yourself conversant with this Act and the regulations made.

You have already been directed by telegraph to take command of the *Cruiser* at Owen Sound, and have her at once fitted for service. The vessel is to be employed for the present season in Lake Huron and the Georgian bay, in the joint protectorate of the customs and the fisheries.

Your instructions and authority as to the former service will be furnished you by the Customs Department, to which department you will report on all matters connected with that branch of the service.

You will proceed with all possible despatch to cruise in the Georgian bay, calling first upon Fishery Overseer Shackleton, at Colpoy's Bay. It is desirable that you should take him on board the *Cruiser* and go over his district with him. From Overseer Shackleton and the other overseers upon whom you may subsequently call, you may obtain much general information as regards the fisheries, especially looking to an evil which the department believes to exist in the unlimited use of gill-nets and the totally inadequate fee of \$5 per boat, which is now paid for the privilege of a season's fishing with 6,000 yards of gill nets.

After leaving Overseer Shackleton, you will (unless more important work present itself), visit Overseer George S. Miller, at Owen Sound, and in turn F. G. M. Fraser at Victoria Harbour.

Upon completing an inspection of the districts of these overseers, you had better proceed to Manitowaning, and there take on board Overseer A. Drinkwater. It is desirable that he should accompany you around Fitzwilliam, Club Squaw and other islands south of Manitoulin island. You will then work your way to Sault Ste. Marie, calling upon Captain Joseph Wilson, fishery overseer at the Sault. You will find Captain Wilson an officer of large experience and able to give you much valuable information, both as regards the customs and the fisheries.

If it can be arranged that Captain Wilson should accompany you over his division, you will find his presence of advantage.

The department has reason to believe that considerable fishing is carried on by United States subjects in the Georgian bay, without having taken out a license. It will therefore be your duty to speak all boats you may see fishing. Ascertain the names of the owners and where the boats belong.

To aid you in detecting illegal fishing, a list of the licenses that have been issued through the several overseers is inclosed herewith.

In carrying out the general instructions hereby conveyed, you are at liberty to exercise your judgment in deviating therefrom for the purpose of examining any matters appertaining to the customs service, which you may deem essential.

You are required to carry out the service committed to your charge with the due regard to economy, and at all times keep in view its efficiency, taking notes in all points relating to the fisheries which you may deem of interest to the department.

The length of nets, the service of the mesh, the number of men employed, the markets in which the fish are disposed of, the due observance of the close season, are all details which may profitably engage your attention. The inclosed pay-list will inform you as to the crew carried by the *Cruiser* last season; this number is not to be

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exceeded without the department's authority. You will furnish weekly to this department a copy of the *Cruiser's* log and also fill in the boarding reports with which you have been furnished. The crew will be paid monthly upon a pay-list certified by you and transmitted to the department.

In navigating your vessel, there is no need that any risk should be incurred, and you will always have regard for the responsibility attaching to your command. Whenever in waters with which you are not familiar and the presence of a pilot is necessary, you are authorized to engage one. All accounts for supplies or fuel furnished the *Cruiser* are to be rendered in duplicate and certified by you as correct, both as regards the quantity and price, and transmitted to the department for payment. Such reasonable advances for the steamer's incidental expenses as may be necessary, will from time to time be made to you.

The size of the mesh of nets having been fixed at $4\frac{1}{2}$ inches, you are to take great care that no nets are allowed to be used under this size, and if such are found in use, they are to be seized and destroyed, and you are to prosecute all offenders for any irregularities.

Discretionary power with reference to the offences against the Fisheries Act or Regulations is alone to be exercised by the Minister, after having from you a full report of the case requiring consideration.

The close season for salmon trout and whitefish is from 1st to 30th of November.

I am, sir, your obedient servant,

(Sgd.) JOHN TILTON,

Deputy Minister of Marine and Fisheries.

Captain E. DUNN,
Owen Sound, Ont.

APPENDIX 'L.'

DEPARTMENT OF STATE,

WASHINGTON, September 5, 1906.

The Honourable,
The Secretary of War.

SIR,—I have the honour to inclose herewith a copy of a letter from Mr. H. C. Schacht, secretary of the Keystone Fish Company, of Erie, Pa., transmitting a communication from the commander of the Canadian cruiser *Vigilant*, proposing to log and mark by buoys the exact international water boundary line, thereby enabling fishermen to keep on their side of the line.

As it is stated that difference of opinion as to the exact location of the boundary line exists between the interested parties, I should be very much obliged if you should cause this to be referred to the International Waterways Commission, with the enquiry whether it is known that the Amercian and Canadian charts of the locality agree as to the distance to be logged from the gas buoy at Erie to the boundary line on the usual fishing grounds. An examination some years ago showed that the maps of the Ghent Commissioners were not accurately scaled, Lake Erie being drawn wider than it really is, so that the distances logged according to those maps from either shore to the treaty boundary as drawn thereon would lap appreciably at the middle of the lake.

I have the honour to be,

Your obedient servant,

ROBERT BACON,

Acting Secretary.

Enclosure.

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From H. C. Schacht as above, August 25, 1905, with inclosure.

KEYSTONE FISH COMPANY,
ERIE, PA., August 25, 1906.

Honourable Secretary of State,
Washington, D.C.

SIR,—Referring to the attached copy of communications received from Capt. Dunn, of the C. G. S. *Vigilant*, would ask if it could not be arranged to have one of the American cutters operate in conjunction with Captain Dunn to establish the exact location of the boundary line.

There seems to be considerable difference of opinion between our captains and Captain Dunn as to the location of the line, and we would urge that immediate action be taken in this matter. There are from 40 to 50 boats operating out of this port at the present time and a seizure may be made any day.

Awaiting your prompt action, we remain,

Respectfully yours,

KEYSTONE FISH CO.,
H. C. SCHACHT, *Secretary*.

Keystone Fish Company,
Erie, Pa.

SIR,—If the fishermen intended setting their nets in their own waters and in the future intend to do so, I would make this proposition to them:

That they furnish several large conspicuous buoys and send a responsible person with me, I will come over there and log the distance for them from the gas buoy at Erie to the line where they usually fish and they will then be enabled to keep on their side of the line if they desire to do so.

They can communicate with me at Port Stanley.

Very truly yours,

E. DUNN,
Commanding *Vigilant*.

DEPARTMENT OF STATE,
WASHINGTON, September 7, 1906.

The Honourable,
The Secretary of State.

SIR,—I have the honour to inclose herewith copy of a letter from the Keystone Fish Company, relative to the seizure by the Canadian cruiser *Vigilant* of the nets of the American steamer *Erie*, and to refer to this department's recent letter (the 5th instant), on the same subject: namely, agreement as to distance to be logged from a fixed point to the boundary line.

The Keystone Company has been advised that the department has taken steps to find out what the line is and that, in the meantime, their remedy is in the Canadian courts.

I have the honour to be, sir,
Your obedient servant,

ROBERT BACON,
Acting Secretary.

7 EDWARD VII., A. 1907

Inclosure,

From Keystone Fish Company, August 21, 1906.

KEYSTONE FISH COMPANY,
Catchers and Shippers of Fresh Fish,
ERIE, PA., August 21, 1906.

Secretary of Treasury,

Department of Customs, Washington, D.C.

SIR.—We wish to call your attention to the high-handed action taken by Captain Dunn, of the Canadian cruiser *Vigilant*.

On August 20 our steamer *Erie* set 112 nets 14½ miles north-northwest of Erie in a southwesterly and northeasterly direction according to hydrographic charts No. 14.477. These nets were set in United States waters. On the 21st the *Erie* was only able to find 16 nets, the balance having been confiscated by the *Vigilant*.

All our captains have positive instructions to keep on this side of the boundary line, and they are as well able to determine the location of the line as Captain Dunn. But neither Captain Dunn nor our captains can determine the location of the line within a few feet.

Could it not be arranged to have an American cutter patrol the line to protect our interests and also definitely determine the location of the line? As it now stands it is left entirely to Captain Dunn.

Our fishing territory is very limited at best, and we demand protection for our property when in United States waters. We are at least entitled to fish up to the line.

If Captain Dunn continues in this manner, our boats will be compelled to stay from one to two miles this side of the line to be safe from confiscation.

Our captains cannot be governed by where the *Vigilant* runs in going up and down the lake, as she varies from three to four miles from day to day.

The nets seized were worth from \$550 to \$600, which amount, we think, should be recovered from the Canadian authorities.

Your prompt attention to this matter will greatly oblige.

Respectfully,

KEYSTONE FISH CO.,
H. C. SCHACHT.

JOINT REPORT ON THE CHICAGO DRAINAGE CANAL, 1907.

INTERNATIONAL WATERWAYS COMMISSION,
TORONTO, ONT., January 4, 1907.

The Honourable Secretary of War of the United States,
The Honourable Minister of Public Works of Canada:

The International Waterways Commission has the honour to submit the following report upon the Chicago Drainage Canal:

1. The headwaters of the Illinois River, an important tributary of the Mississippi, approach within 10 miles of Lake Michigan near its southerly end, where stands Chicago. The river, called here the Des Plaines, is separated from the lake by a low and narrow divide running nearly north and south. In the divide are two depressions, about 8 miles apart, in which the height is only about 10 feet above the surface of the lake. The area eastward of the divide is drained by two streams, the Chicago and the Calumet rivers, which empty into Lake Michigan.

The city of Chicago was originally built on the Chicago river, and, although it is now spreading into the Calumet region, it was for many years drained exclusively by the Chicago river, and its principal parts are now so drained. This river constitutes the main sewer of Chicago. The lake furnishes the city's water supply. To prevent the pollution of the water supply by sewage has always been the most important problem with which Chicago has had to deal. Its solution has from a very early day been found in diverting a part of the river's flow into the valley of the Des Plaines through the most northerly of the two depressions mentioned above. The Illinois and Michigan Canal, which was opened to navigation in 1848, was at once utilized for this purpose, and all subsequent improvements consisted in efforts to force more sewage through that canal until, in 1889, it was decided to build a new and greatly enlarged channel which should completely divert the Chicago river from Lake Michigan and draw from that lake a body of pure water large enough to make the sewage inoffensive to the communities by whose doors it must pass.

2. Before embarking upon this work the city in 1886 appointed a commission of three engineers 'to consider and report on any and all things which relate to the matter of water supply and drainage of the city of Chicago.' In January, 1887, the commission submitted a report to the mayor and city council of Chicago (copy appended marked A), which it styled a preliminary report. It intended to submit an additional or final report in which the data upon which its conclusions were based should be given in greater detail, but such additional report was never submitted. After remarking that 'almost every conceivable way of dealing with these questions had been suggested and in some form applied during the past thirty years,' the commission stated that 'among the possible methods of getting rid of the Chicago sewage there are but three that have been deemed worthy of consideration, namely, a discharge into Lake Michigan, a disposal upon land, and a discharge into the main river.' It considered the first method too expensive, involving as it does a wide separation between the outlets of the sewers and the intakes of the water supply. It pronounced the second inapplicable to the metropolitan district as a whole, under the topographical conditions existing, but thought that it might be employed for the extreme northern and southern parts, the latter including the Calumet region. It recommended the third method. It was uncertain as to the quantity of water required to dilute the sewage so as to make it inoffensive, but in order to prepare an estimate of cost it was compelled to assume some approximate size of channel, and it did assume a size large enough to discharge 600,000 cubic feet per minute, that being the estimated amount of water falling upon the area tributary to the canal during storms and not otherwise disposed of. It includes the drainage basins of the upper Des Plaines and of the Chicago river, but not that of the Calumet river with a channel of less dimensions in times of storms and floods, the Chicago river would not be fully diverted into the Des Plaines, but would back up into Lake Michigan. The result was a supply of 24,-

000 cubic feet per minute for each 100,000 people in a population of 2,500,000, the population which the commission thought it desirable to provide for, and the opinion was expressed that this would equal the maximum requirements.

3. Following this report the Illinois legislature passed an Act approved May 29, 1889, 'to create a sanitary district and to remove obstructions in the Des Plaines and Illinois rivers,' of which the twenty-third and twenty-fourth paragraphs read as follows, viz.:—

'Paragraph 23.—If any channel is constructed under the provisions hereof by means of which any of the waters of Lake Michigan shall be caused to pass into the Des Plaines or Illinois rivers, such channel shall be constructed of sufficient size and capacity to produce and maintain at all times a continuous flow of not less than 300,000 cubic feet of water per minute, and to be of a depth of not less than 14 feet, and a current not exceeding 3 miles per hour, and if any portion of any such channel shall be cut through a territory with a rocky stratum where such rocky stratum is above a grade sufficient to produce a depth of water from Lake Michigan of not less than 18 feet, such portion of said channel shall have double the flowing capacity above provided for, and a width of not less than 160 feet at the bottom capable of producing a depth of not less than 18 feet of water. If the population of the district draining into such channel shall at any time exceed 1,500,000, such channel shall be made and kept of such size and in such condition that it will produce and maintain at all times a continuous flow of not less than 20,000 cubic feet of water per minute for each 100,000 of the population of such district, at a current of not more than 3 miles per hour, and if at any time the general government shall improve the Des Plaines or Illinois rivers, so that the same shall be capable of receiving a flow of 600,000 cubic feet of water per minute, or more, from said channel, and shall provide for the payment of all damages which any extra flow above 300,000 cubic feet of water per minute from such channel may cause to private property so as to save harmless the said district from all liability therefrom, then such sanitary district shall, within one year thereafter, enlarge the entire channel leading into said Des Plaines or Illinois rivers from said district to a sufficient size and capacity to produce and maintain a continuous flow throughout the same of not less than 600,000 cubic feet of water per minute, with a current of not more than 3 miles per hour, and such channel shall be constructed upon such grade as to be capable of producing a depth of water of not less than 18 feet throughout said channel, and shall have a width of not less than 160 feet at the bottom. In case a channel is constructed in the Des Plaines river, as contemplated in this section, it shall be carried down the slope between Lockport and Joliet to the pool commonly known as the upper basin, of sufficient width and depth to carry off the water the channel shall bring down from above. The district constructing a channel to carry water from Lake Michigan of any amount authorized by this Act may correct, modify, and remove obstructions in the Des Plaines and Illinois rivers, wherever it shall be necessary so to do to prevent overflow or damage along said river, and shall remove the dams at Henry and Copperas Creek, in the Illinois river, before any water shall be turned into the said channel. And the canal commissioners, if they shall find at any time that an additional supply of water has been added to either of said rivers by any drainage district or districts, to maintain a depth of not less than 6 feet from any dam owned by the State to and into the first lock of the Illinois and Michigan canal at La Salle, without the aid of any such dam, at low water, then it shall be the duty of said canal commissioners to cause such dam or dams to be removed. This Act shall not be construed to authorize the injury or destruction of existing water-power rights.

'Paragraph 24. When such channel shall be completed, and the water turned therein, to the amount of 300,000 cubic feet of water per minute, the same is hereby declared a navigable stream, and whenever the General Government shall improve the Des Plaines and Illinois rivers for navigation, to connect with this channel, said General Government shall have full control over the same for navigation purposes, but not to interfere with its control for sanitary or drainage purposes.'

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By this Act a flow of not less than 20,000 cubic feet per minute is required for each 100,000 inhabitants and provision is made for a population of 3,000,000. The evidence before the legislative committee which framed the Bill as to the quantity required was contradictory. The amount fixed for dilution of the sewage was a minimum. (See Appendix B.)

4. Under this Act the sanitary district of Chicago was organized, embracing all of the city north of Eighty-seventh street and some 43 square miles of Cook county outside of the city limits. The total area of the district was 185 square miles, and did not include the Calumet region nor the north shore. The trustees held their first meeting January 18, 1890. The Chicago Drainage Canal was then constructed, water being turned into it for the first time in January, 1900. It was not then, and has not since, been completed to its full capacity as designed. In places where the excavation was in rock the full dimensions of the prism were taken out, but in earth a considerable volume was left to be removed by the easy method of dredging hereafter. When fully completed it was designed to have a capacity of 600,000 cubic feet per minute, or 10,000 cubic feet per second, flowing at a velocity of 1.25 miles per hour in earth and 1.9 miles per hour in rock.

5. The canal is 28.05 miles in length. For a distance of 7.8 miles from its junction with the Chicago river at Robey street its dimensions are 110 feet width at bottom, side slopes 1 on 2, depth of water 22 feet at low stage of Lake Michigan, with a grade of 1 in 40,000, the material being earth. This section is eventually to have a width of 200 feet at bottom.

6. For a farther distance of 5.3 miles, although the material is principally earth, the dimensions are 202 feet width at bottom, side slopes 1 on 2, minimum depth of water 22 feet, with a grade of 1 in 40,000. This section is completed.

7. For the remaining 15.95 miles the canal is excavated wholly or partially in rock. Where the natural rock does not come to the surface walls of masonry have been built upon the rock surface, thus artificially carrying it to a height 5 feet above datum. The dimensions here are 160 feet width at bottom, 162 feet width at top, minimum depth of water 22 feet, with a grade of 1 in 20,000. This section also is completed.

8. The controlling works are situated near the town of Lockport at the western end of the canal. They consist of a bear trap dam 160 feet wide, with a vertical play of 17 feet, and of seven sluice gates of the Stoney type, each 30 feet wide and having a vertical play of 20 feet. These works provide a very efficient means of controlling the flow of water through the canal.

9. The project of the sanitary district for the disposal of sewage by the canal when completed is briefly as follows: All sewers will discharge into the Chicago river, either directly or through intercepting sewers. From the mouth in Lake Michigan to the point where the North and South branches unite the river will flow 8,000 cubic feet per second, less such quantity as may be pumped into the upper portion of the North branch, which under the original project was 200 cubic feet per second admitted through a conduit at Fullerton avenue. From this point the combined flow will be 8,000 cubic feet to the point where the South Fork enters the South branch, where it will be increased to 10,000 cubic feet by water pumped from Lake Michigan at Thirty-ninth street and flowing through a large conduit in Thirty-ninth street to the South fork. The volume which will finally enter the canal under this project will be 10,000 cubic feet per second.

10. The channel of the Chicago river is not large enough to transmit that volume from the lake to the canal except at velocities which are an obstruction to navigation. The amount which the Secretary of War has thus far permitted the sanitary district to pass through the river is 4,167 cubic feet per second. In order to obtain authority for a larger amount the trustees have undertaken to enlarge the channel of the river and have accomplished a large amount of work in that direction.

11. By act of the Illinois legislature in 1903 the sanitary district was enlarged by annexing thereto the north shore district, containing 78.6 square miles, and the Calumet district, containing 94.48 square miles. The total area of the sanitary district

is therefore now 358.08 square miles. The same legislature authorized the development of the water power created by the diversion.

12. The plans for the north shore region involve two additional conduits from the lake to the North Branch of the Chicago river, one at Lawrence avenue, into which 583 cubic feet per second, and one at Wilmette, into which 1,000 cubic feet per second, are to be pumped. As this water is to form a part of the 10,000 cubic feet originally to be taken out through that river, it does not add to the amount of water to be taken from Lake Michigan.

13. The plans for the Calumet region involve a treatment of the Calumet river similar to that of the Chicago river. The river is to be diverted into the Des Plaines Valley. For this purpose a new channel is to be cut through the southerly depression in the divide, and to join the present drainage canal at Sag, about 11 miles from the controlling works at Lockport. From Sag to Lockport the drainage canal must carry the flow from the Calumet river in addition to that from the Chicago river. It was designed to accommodate the latter river alone, or 10,000 cubic feet per second, but improved methods of excavation, particularly channeling in rock, gave it a greater capacity than was computed; and the hydraulic formulæ with which its dimensions were figured, being adapted to smaller streams, gave results which proved to be too large. It is found that the portion completed in rock, which includes the reach from Sag to Lockport, will carry an amount stated by the Chief Engineer to be 14,000 cubic feet per second. The difference, 4,000 cubic feet per second, is the amount which it is proposed to divert from the Calumet river. For this purpose it is proposed to excavate a channel having in earth a bottom width of 72 feet, with side slopes 3 on 5, and in rock a bottom width of 90 feet with vertical sides, the depth in both cases to be 25 feet.

14. Work in the territory annexed in 1903 has been limited to surveys, and the preparation of plans, and the expenditures in that territory have been small. The amount expended upon the drainage canal and accessory works, including the above, to December 31, 1905, is \$40,873,629.71; in addition to which \$1,556,226.56 has been expended for the development of water power and \$7,290,101.27 has been paid out for interest. For a financial statement more in detail, see Appendix C.

15. Although the primary object of the Chicago Drainage Canal was the discharge of Chicago sewage, its function as a channel for navigation was kept in view from the beginning. All of the bridges over it are draw bridges with ample openings. A provision of this kind, as well as the care exercised to make the sewage inoffensive by liberal dilution, was necessary to conciliate the interests in the valley of the Des Plaines and Illinois rivers, which would otherwise be adversely affected. It can hardly be doubted that the canal will eventually form a part of an improved waterway between the Great Lakes and the Mississippi river, though its full depth will probably not be required for that purpose. Congress has not adopted any scheme for this improvement, but by its direction a survey was made, and plans with estimates for a waterway 14 feet deep were submitted, by a board of engineers in a report dated August 26, 1905. The board found that for a distance of about 100 miles from Chicago the improvement must be with locks and dams, and as the quantity of water required would be merely that needed for the service of locks and other incidentals, the extent of the improvement or depth which could be obtained in that part of the route was without limit so far as it depended upon the amount of water available. For the remaining distance, about 223 miles, the improvement would be an enlargement of the open channel and the degree to which it was practicable was entirely dependent upon the quantity of water flowing. The board assumed that the Chicago Drainage Canal would eventually be permitted to take 10,000 cubic feet per second from Lake Michigan, and it expressed the opinion that with that volume added to the natural low water discharge of the Illinois river a depth of 14 feet in the open channel could be maintained; also that if a much greater depth was to be secured a much larger volume of water must be taken from Lake Michigan.

16. In the neighbourhood of Lockport the natural level of the ground falls away rapidly and excellent facilities are found for the development of water power. Under

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the State legislation of 1903 the sanitary district is now engaged in utilizing this incidental advantage of the drainage canal. The plans provide for an extension of the canal 10,700 feet between concrete walls and earth and rock embankments to the site selected for the power house and for the excavation of a tail race 6,800 feet long, 160 feet wide, and 22 feet deep. If the maximum quantity of water which the sanitary district now claims to be necessary for sanitary purposes—14,000 feet per second—be utilized it will be possible to develop about 40,000 electrical horse-power under a head of 34 feet. With 10,000 cubic feet per second about 28,000 horse-power can be developed. A power house is being erected which will accommodate 8 turbines, each capable of generating 5,000 horse-power.

17. The sanitary district has acquired land on both sides of the canal throughout its length, the width of the strips varying from 200 to 800 feet. This land is offered to manufacturers at moderate prices, and it seems probable that they will in the course of time be attracted thereto, particularly after arrangements for furnishing them with cheap power from Lockport are completed.

18. The diversion of large bodies of water from Lake Michigan for supplying the drainage canal has not been authorized by Congress. The plans of the sanitary district, except those for the enlargement of the Chicago river, have not been submitted to any Federal authority for approval. It was only after the opening of the canal that application was made to the Secretary of War for permission to divert the quantity of water required by the State law. The Secretary granted permission for such quantity as would pass through Chicago river without detriment to navigation, a quantity considerably less than that required by the State law. After experimenting with various amounts it was fixed at 250,000 cubic feet per minute, or 4,167 cubic feet per second, and that is the amount now authorized. It is 'subject to such modification as, in the opinion of the Secretary of War, the public interests may from time to time require.' Copies of all the permits granted by the Secretary of War in this connection will be found in Appendix D.

19. In the expenditure of \$40,000,000 for the drainage canal the people of Chicago, with its population of 2,000,000, incurred a burden equivalent to that due to an expenditure of \$1,600,000,000 by the United States, with its population of 80,000,000—that is, enough to build eight or more Panama canals. It was a very serious effort and has commanded the admiration and sympathy of all observers. The diversion of 10,000 cubic feet per second from Lake Michigan affects other interests adversely, but these interests have withheld their opposition, seeming to believe that some such amount was necessary, and apparently willing to contribute their share to protect the lives and health of the people of a great city. The plans calling for that amount have been under public discussion for some years. Although withholding formal approval, the Federal authorities have taken no steps to prevent their execution. Congress has called for a plan and estimates for an improvement of the waterways connecting with it, the scope of which is fixed by that amount. There appears to be a tacit general agreement that Chicago needs or will need about 10,000 cubic feet of water per second for sanitary purposes and that the city should have it without further question.

20. It was not generally known until after the publication in March last of the report of the American section of this Commission upon Niagara Falls that an amount greater than 10,000 cubic feet per second would be asked for. In that report, subsequently concurred in by the Canadian section, it was recommended that the diversion of 10,000 cubic feet be allowed. The preservation of Niagara Falls alone was considered, and that in the light of the tacit agreement above described. It was supposed at the time that this was all that Chicago needed, but the recommendation gave offence to the officials of the sanitary district, and the further demand then came out in the form of appeals to the committees of Congress and to the Secretary of State. It is necessary now to take up the question anew, and, after considering it in all its bearings, to reach some conclusion as to whether there should be a limit to the amount of water to be diverted at Chicago, and, if so, as to what that limit is.

21. That the abstraction of water from Lake Michigan has a tendency to lower the level of that lake and of all the waters to which it is tributary is self-evident ; but the exact effect of abstracting a given amount can be ascertained only from prolonged observation of the natural outlets under the varying conditions to which they are subjected during a series of years. An elaborate investigation of this subject was made under the office of the United States Lake Survey in Detroit, the results of which were published in the annual reports of the Chief of Engineers for 1900, page 5401; for 1902, pages 2779 and 2825; and for 1904, page 4120. Further observations are needed to be made when the difference of level between Lake Erie and Lake Huron is greater or less than when the existing observations were made, but the results obtained from the latter are believed to be reliable within one-tenth of a foot. The amounts by which the mean level, as derived from observations of the last forty-six years, of the various waters will be lowered by a discharge of 10,000 and also by 14,000 cubic feet per second are given in the following table :—

Location.	Water level lowered by diversion at Chi- cago of—	
	10,000 cubic feet per second.	14,000 cubic feet per second.
	Inch.	Inch.
Lakes Huron and Michigan.....	0 52	0 70
Lake St. Clair.....	0 45	0 64
Lake Erie.....	0 45	0 64
Lake Ontario.....	0 35	0 49
St. Lawrence River and Rapide Plat.....	0 40	0 56

From this table it appears that all the waters, including Lakes Michigan and Huron, Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence river, besides the important connecting channels, the Detroit and St. Clair rivers, will be lowered by amounts varying from 4½ to 6½ inches for 10,000 cubic feet and from 6 to 8½ inches for 14,000 cubic feet per second. The length of time required to produce this effect is about five years ; about half of it will be produced at the end of eighteen months. The above figures give the effect at average level ; they are much more considerable during low water periods.

22. Variations in the level of the lakes' surface, due to winds and to change of barometric pressure, are frequent and irregular and at times violent. Variations of more than 6 inches are very common, often occurring hourly for many hours in succession, while variations of 2 or 3 feet within an hour are not uncommon. Besides these irregular variations there is a regular annual variation due to difference in rainfall, evaporation, and run-off, the water level being highest in midsummer and lowest in midwinter. The levels are affected also by the greater or less severity of the winter and the consequent greater or less decrease in the discharging capacity of the outlets by ice. In order to study the annual oscillations it is necessary to eliminate the irregular oscillations, and that is accomplished by using the average levels for a month. Using the monthly mean levels it is found that the regular fluctuation in Lake Huron-Michigan usually does not exceed 2 feet in any one year, but in a long series of years there is a great difference in the height to which high water will rise. The highest water (monthly mean) recorded for that lake was in June, 1886, and the lowest high water in June, 1896, the difference between the two being over 3½ feet. The first is what navigators of the Great Lakes call a high-water year and the second a low-water year.

23. It is evident that the average level of the lake may be lowered considerably without the change becoming immediately apparent, and that fact has been used as an argument to prove that the lowering caused by the Chicago Drainage Canal is of

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no consequence to those interested in navigation. Since they can not see it they will not know it and will not feel it. The argument is fallacious. It is true that they can not see it immediately, but they will soon feel it and will know it through the most costly means of acquiring knowledge—the injury to their material interests. The oscillations will remain the same as before, but low water will fall lower and high water will rise less high. The average draft of vessels must be diminished by the amount that the average level is lowered unless the depth be restored by remedial works.

24. The most important lake traffic is now carried on in large freight carriers which are loaded down to the greatest draft that can be carried into the harbours or through the channels between the lakes. With the depth now available they are usually loaded to a draft of about 19 feet, but careful watch is kept on the stage of the waterways and advantage is taken of any temporary increase of stage to load the vessels deeper. In the modern vessel each inch of increased draft adds about 50 tons to the carrying capacity. To lower the water surface 6 inches is to reduce the capacity of the vessel about 300 tons. If the freight rate on iron ore be taken at 55 cents per ton, exclusive of the cost of loading and unloading, and the number of trips during the season at 22, there appears a loss of over \$3,600 for the season for each vessel. The number of vessels navigating the Great Lakes which draw 19 feet or more is 417, and their tonnage is 1,541,414 tons, which is about three-quarters of the total tonnage of the Great Lakes. It is a conservative estimate that the loss to the navigation interest resulting from a reduction of 6 inches in the depth of water is \$1,500,000 per annum, which, capitalized at 4 per cent, amounts to a loss of \$37,500,000. With a greater reduction of depth the resulting loss would be proportionately greater. The number of deep-draft vessels and the share of lake traffic which they carry is increasing each year, while the lake traffic itself is increasing with marvellous rapidity. The total number of tons of freight which passed through Detroit river in 1905 was about 58,000,000, valued at about \$615,000,000. The records for the year 1906, so far as they are made up, indicate that the number of tons which passed through the Detroit river in 1906 exceeded 65,000,000, valued at \$690,000,000. The loss will be even greater in the future than it is now. It is quite certain that the loss will not pass unnoticed, and that the governments will be compelled to restore the depth either by additional excavations or by regulating works.

25. Careful estimates have been made of the cost of deepening the channels between the lakes 1 foot. To deepen the Detroit river is estimated to cost \$4,115,430. In Lake St. Clair the full depth of the lake is now utilized, and any lowering of its surface involves the excavation of an artificial channel entirely across the lake, a distance of 18 miles, of which it has been necessary heretofore to artificially deepen only one-third. To deepen the channel here and at certain shoal places in St. Clair river and at the foot of Lake Huron is estimated to cost \$1,080,720. It results in replacing open lake navigation by canal navigation for a distance of 12 miles in Lake St. Clair, a decided disadvantage.

26. The data are not at hand for an accurate estimate of the cost of restoring the depths in the harbours of the Great Lakes, but an approximation may be reached from a consideration of the cost of improvements heretofore made. The depth to be gained being small, the cost will not vary largely, whether that gain be a few inches more or less. The United States has improved thirty-five harbours on Lakes Michigan, Huron and Erie, and has expended thereon about \$20,000,000, of which about one-quarter was for maintenance. The average increase of depth is 10 feet and the cost per foot of increase was therefore about \$1,500,000, but as the cost of a small increase would be much greater per foot than an increase of 10 feet, and as several harbours on Lake Ontario are to be added, the cost per foot in this case would probably be not less than \$2,000,000 for harbours in the United States. The Canadian government has improved over fifty harbours on Georgian bay, Lakes Huron, St. Clair, Erie and Ontario. A large amount, say \$3,000,000, must be added for increasing the depth of these harbours.

27. The depth in the Welland canal and in the six canals employed to overcome rapids in the St. Lawrence river is now 14 feet, of which every inch is needed. At the head of the Cornwall canal in the St. Lawrence river the abstraction of 14,000 cubic feet of water per second at Chicago will lower the surface about $6\frac{3}{4}$ inches at mean level and much more at low water. To restore the depth in these canals involves the reconstruction of all the end locks and deepening the approaches thereto, and is estimated to cost \$2,500,000.

28. The total cost of restoring the depth in the harbours of the Great Lakes and the channels between the lakes is therefore roughly \$10,000,000, and of restoring it in the Welland and St. Lawrence canals is \$2,500,000 additional, or \$12,500,000 in all.

29. The shores of the Great Lakes are very far from being fully developed, and it is highly probable that many harbours not now in existence remain to be created, or if in existence remain to be improved. The lowering of the lakes' surfaces increases the difficulty and cost of such improvements. This consideration is of importance, although no money value can now be given it.

30. The expenditure of the sums mentioned above will restore the depths now existing, but it will not prevent very serious annoyance to the navigation interests during the execution of the work. The time required will be several years, and in the meantime the vast commerce of the Great Lakes will be hampered, not only by deficient depth, but also by the occupation of the channels, already crowded with commerce, by the excavating machines.

31. It is evident from the foregoing that large bodies of water can not be diverted by the Chicago drainage canal without very serious detriment to the navigation interests of the Great Lakes and of the St. Lawrence valley. The greater the amount of water diverted the greater the injury. Chicago being one of the principal lake ports, there will be very few communities which will feel this detriment more than she will.

32. In the presence of these interests the effect upon Niagara falls may be simply mentioned with a reference to our former reports upon that subject. The volume of Niagara falls will be reduced by the full amount diverted at Chicago.

33. The city of Chicago was organized as a city in 1837, with a population of about 4,000. Its population in 1840 was 4,479; in 1850, 28,269; in 1860, 112,172; in 1870, 298,977; in 1880, 503,185; in 1890, 1,099,850; and in 1900 it was 1,698,575. It is estimated now to be about 2,000,000. Should the rate of growth continue which prevailed between 1880 and 1900, the population will be 3,000,000 in the year 1922 and 4,000,000 in the year 1939. It is impossible to foretell its future growth, but there is no reason to doubt that it will in time greatly exceed the largest of these numbers. The city is the commercial centre of an empire still in its infancy. It is entirely reasonable to expect a population of five or six millions or more. It will cover territory not now covered. Methods of sewage disposal appropriate to one portion of it may not be appropriate to other portions. If the diversion of 20,000 cubic feet per minute (or $333\frac{1}{3}$ cubic feet per second) for each 100,000 of population, as required by the State law, is accepted as the standard, then from 17,000 to 20,000 cubic feet per second will be required, and the 14,000 cubic feet now contemplated will not be sufficient. Even more than 20,000 cubic feet will be required for a population greater than 6,000,000. The diversion of 20,000 cubic feet per second would lower Lakes Michigan and Huron about 13 inches and Lake Erie about 11 inches. Plans which lead to this result should be carefully scrutinized.

34. One of the reasons given in 1889 for adopting this method of disposing of Chicago sewage was that it offered the advantage of furnishing a navigable waterway from Chicago to the Mississippi river. The navigable depth or capacity of such a waterway has never been authoritatively fixed. Congress has considered a depth of 14 feet to the extent of ordering a survey and estimates of cost for that depth, but the Illinois legislature has declared its policy to be to secure the construction of a deeper channel, not limiting its proposed capacity in terms, but defining it to be 'of the greatest practicable depth and usefulness for navigation.' See joint resolutions adopted May 27, 1889, copy omitting preamble hereto appended, marked 'E.' A fair

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interpretation of this language gives a proposed depth of 20 feet, that being the depth required to accommodate the most important vessels now navigating the Great Lakes. It will require a volume of water greater than the 10,000 cubic feet per second originally contemplated.

35. The amount which it is proposed to divert from the Calumet river, 4,000 cubic feet per second, is fixed by accident rather than by design, being the excess which the Chicago drainage canal is found capable of carrying after providing for the 10,000 cubic feet from the Chicago river, for which it was originally constructed. It is certain that no greater amount than 4,000 cubic feet can be diverted from the Calumet without checking the flow from the Chicago river, and thus giving relief to a suburban portion of the city at the expense of the richest and most populous centres.

36. It is equally certain that the diversion of 4,000 cubic feet or less will not at all times afford the desired relief to the Calumet. In the first place it provides for a population of only 1,200,000, a number which will in all probability be greatly exceeded at a day not remote. At present the population is estimated at about 200,000, but for the present necessities it is not a question of population, but of drainage area and rainfall. A flood discharge of the Calumet has been measured at Riverdale, about 10 miles from its mouth, of about 13,300 cubic feet per second from a drainage area of about 700 square miles, and even that amount may at times be exceeded. The total drainage area of the Calumet region, including the Sag Valley, is about 825 square miles, and assuming the discharge to increase in proportion to the area, the flood discharge to be provided for is over 15,700 cubic feet per second. The diversion of only 4,000 cubic feet will not prevent a heavy discharge into Lake Michigan in time of flood. To overcome this difficulty it is proposed, if suitable legislation can be secured, to divert the upper Calumet into Lake Michigan through an artificial channel to be excavated in Indiana about 17½ miles east of the State line. Indiana has not authorized such diversion, but supposing it to be accomplished, there will still be times when the discharge from the drainage area remaining to be cared for by the canal, 238 square miles, will exceed 4,000 cubic feet per second. The excess must enter Lake Michigan through the mouth of the Calumet, and at such times the system will fail. Of course, it makes no provision for the future occupation of the upper Calumet region and the pollution of the lake from that source. It thus appears that the diversion of the Calumet river as now proposed by the sanitary district will not be complete even for the present, and will not make adequate provision for the future.

37. The diversion of 4,000 cubic feet per second provides for a population of 1,200,000 by the standard fixed by the State law. The population of the Calumet region is now about 200,000, and until it reaches 1,200,000 only a part of the flow will be needed for sanitary purposes during a large part of the year; but the channel must be there, available for the full flow, if this method of sewage disposal is to be useful to any population, however small. Likewise the channel from the Chicago river must be, as it is, large enough to provide for a population of 3,000,000, whether that number of people are ever to become tributary to the Chicago river or not. The channels having once been constructed, any reduction of flow below their fullest capacity is a dead loss to the water-power dependent upon them. It has been said that it would be absurd to develop water-power at the cost per horse-power which this water-power costs if the drainage canal be included, and that is true. But being given the channels, it would not be absurd to use them to their fullest capacity. The Chicago Drainage Canal having been constructed with a capacity, as it turns out, of 14,000 cubic feet per second, full power development will call for the whole of that amount, and in fact power works are now under construction at Lockport to utilize it. Inasmuch as the sanitary requirements by the standard, fixed in the State law, are only 6,667 cubic feet per second for the present population of 2,000,000, it is evident that power development, incidental though it be, does lead to demands for water not required for sanitary purposes.

38. It remains to be seen whether any diversion, complete or otherwise, is necessary to preserve the health of Chicago. Upon this point the commission sought the

advice of two eminent sanitary engineers—Messrs. Rudolph Hering and George W. Fuller—whom it instructed as follows, viz.: ‘To examine the sanitary situation at Chicago, so far as it is affected by sewage disposal, and to report whether it is or is not necessary to the health of the city to extend to outlying territory the system which was adopted in 1889 for the main city. * * * The commission desires an emphatic opinion from authoritative sources as to whether the system of diverting the water of Lake Michigan in large quantities into the Illinois Valley is the only way to preserve the lives and health of the people of Chicago. It does not desire an investigation of the effect upon the navigation interests of the Great Lakes. It has satisfied itself upon that point. Nor does it wish to reopen the case of the Chicago Drainage Canal as designed and built. It accepts that as a fixed fact, with its attendant diversion of 10,000 cubic feet per second through the Chicago river. The extension of the system to the Calumet river alone is in question, and the question is, Are there not other methods of sewage disposal which can be applied here at a cost not exceeding much, if at all, the cost of the method proposed, and which will be equally effective in preventing the pollution of the lake? It desires a report upon the various systems which may be found available for application here, with a statement of their relative efficiency. It also desires a statement of their relative cost, so far as that can be given, without the preparation of detailed plans. The latest conclusions of sanitary engineers as to the amount of dilution which is required to make sewage inoffensive should be given.’ These gentlemen visited Chicago, and after a thorough examination of the situation submitted a report, of which a copy is hereto appended, marked ‘F.’ The entire report should be carefully studied. Its conclusions only are here quoted. They are as follows, viz.:—

‘The latest conclusions of sanitary engineers as to the amount of dilution which is required to make sewage inoffensive are that a dilution of $3\frac{1}{2}$ cubic feet per second for each 1,000 persons connected with the sewers, as provided for in the enactment of the Illinois legislature in 1889, is as low a figure as it is now possible to state. We believe that with the elimination of objectionable trade wastes and the occasional dredging of the river this amount of dilution will be sufficient to prevent offensiveness.

The extension of the dilution method to the outlying territory is not the only way to preserve the lives and health of the people of Chicago. The application of this method, with flow of 10,000 and 14,000 cubic feet per second, respectively, for the area tributary to the present drainage canal, will serve populations not exceeding 3,000,000 and 4,200,000 respectively. For greater populations other methods of sewage disposal will be required.

For the Calumet area, as well as other districts, there are several methods for the disposal of sewage as effective as the present method of dilution in preventing the pollution of the lake waters.

All these methods involve intercepting sewers and pumping stations to collect and deliver the sewage at suitable sites. Septic tanks are used for partially clarifying the sewage, which may then be applied to any one of three methods of filters, viz., intermittent sand filters, contact filters, and sprinkling filters.

All of these filters if well built and well managed remove the suspended and organic matters so that the effluents are practically clear and nonputrescible. The removal of bacteria by these three types of filters averages at least 98, 80, and 90 per cent respectively. Such effluents may be discharged into any of the water courses of the Calumet region.

The approximate total costs, liberally estimated, without the preparation of detailed plans, for a population of 1,200,000, are as follows:—

A.—Intermittent sand filters.

Construction.....	\$11,063,000
Annual cost of operation, \$866,000, capitalized at 5 per cent....	17,320,000
	<hr/>
	\$28,383,000
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B.—*Contact filters.*

Construction.....	\$11,787,500
Annual cost of operation, \$551,000, capitalized at 5 per cent..	11,020,000
	<hr/>
	\$22,807,500
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C.—*Sprinkling filters.*

Construction.....	\$ 9,257,500
Annual cost of operation, \$419,000, capitalized at 5 per cent....	8,380,000
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	\$17,637,500
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The present population on the Calumet area of the sanitary district being less than 200,000 would naturally require but a portion of the cost of estimated works and of their operation to be expended at the outset.

Of the available methods of disposing of the sewage of the Calumet area other than by dilution, the sprinkling filter method, being the cheapest both in cost of construction and of operation and accomplishing an adequate degree of purification, is clearly the most advantageous one.'

These engineers stand in the front rank of their profession as sanitary experts. One of them, Mr. Hering, was chairman of the commission of 1887, whose report to the Mayor and city council of Chicago was the foundation of the subsequent legislation and led to the construction of the drainage canal. The conclusions reached are those of friends of Chicago, and not of her enemies or rivals.

39. A method of sewage disposal for the Calumet region is proposed which for a population of 1,200,000 is estimated to cost \$17,637,500. For the present population of about 200,000 only a part of the expense need be incurred, and the works can be developed as the population increases. It can, when the necessity arises, be applied with a population much exceeding 1,200,000. The cost of diverting the Calumet river into the Chicago drainage canal is estimated at \$12,000,000. The greater efficiency at present and in the future of the method now proposed would justify a considerable increase of cost, but in view of the fact that the entire expense of the diversion must be incurred at the outset, while by the new method the expenditures will be regulated by the growth of population, the difference in cost may be considered unimportant.

SUMMARY.

40. The following is a summary of the more important facts recited in this report:

(a) Chicago obtains its water supply from Lake Michigan, and to avoid polluting it must either dispose of its sewage otherwise than in the lake or place its intakes for water at a great distance from the city.

(b) The topography of the country favours the discharge of the sewage into the Des Plaines river, a tributary of the Mississippi, through two depressions in the divide which separates that river from Lake Michigan.

(c) The slope on the lake side of the divide is drained by two streams, the Chicago river and the Calumet river, into which the sewers of the city empty. By a cut through the northerly depression the flow of the Chicago river has been reversed and diverted into the Des Plaines river instead of into Lake Michigan, and by a cut through the southerly depression the same process can be applied to the Calumet river.

(d) To make this reversal effective the channels must be large enough to take all the water which falls upon the respective drainage areas during the most violent rain storms. This amount is estimated at 10,000 cubic feet per second for the Chicago river and 15,700 cubic feet per second for the Calumet river.

(e) The city of Chicago was originally built upon the Chicago river, and that stream now drains the richest and most populous part of the city. It is now spreading over the Calumet region.

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(f) In 1889 the plan of diverting the Chicago river into the valley of the Des Plaines was definitively adopted, and the Chicago drainage canal was undertaken. It was designed to carry 10,000 cubic feet per second. Though not entirely completed, it has been in use since January, 1900. The amount expended upon the canal and accessory work is about \$41,000,000.

(g) The Illinois law which authorized the canal required a flow of 333 cubic feet per second for each 100,000 of population in order to render the sewage inoffensive. This amount of dilution is probably not excessive. It is reasonable to expect a population in a future not remote of five or six millions or more, involving the diversion by this standard of some 20,000 cubic feet per second. The Chicago river with its 10,000 cubic feet provides for a population of 3,000,000. The present population of the city is about 2,000,000.

(h) It is now proposed to apply to the Calumet river a treatment similar to that applied to the Chicago river, viz.: to reverse its flow; so that instead of discharging into Lake Michigan it shall discharge into the Des Plaines, but for a part of the new route it must follow the drainage canal already excavated for the Chicago river.

(i) Although the Chicago drainage canal was designed to carry 10,000 cubic feet per second, it is found to have, in its completed rock portion, an actual capacity of 14,000 cubic feet. This additional capacity fixes the amount which it is proposed to divert from the Calumet at 4,000 cubic feet per second. Any greater amount from the Calumet will overtax the drainage canal at the expense of the richest part of Chicago and for the benefit of a suburban part.

(k) The diversion of only 4,000 cubic feet will not be effective at all times, since a much greater amount must be diverted from the Calumet during heavy rain storms if the lake is to be protected. Moreover, it provides for a population not exceeding 1,200,000, which number will probably be exceeded at a date not far distant.

(l) The large channels necessary to provide for the contingencies of rain storms are capable of discharging a volume of water largely in excess of sanitary requirements during the greater part of the year, but the development of water-power creates the demand that they be employed to their full capacity throughout the year.

(m) The diversion of large bodies of water from Lake Michigan for supplying the drainage canal has not been authorized by Congress, but there appears to be a tacit general agreement that no objection will be made to the diversion of 10,000 cubic feet per second, as originally planned.

(n) The diversion of 10,000 cubic feet per second will lower the levels of Lake Michigan-Huron, Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence river, besides the important connecting channels, the Detroit and St. Clair rivers, by amounts varying from $4\frac{1}{4}$ to $6\frac{1}{4}$ inches for the different waters, and the diversion of 14,000 cubic feet will lower them from 6 to $8\frac{1}{2}$ inches. The diversion of 20,000 cubic feet will lower Lake Michigan-Huron about 13 inches and Lake Erie about 11 inches.

(o) The lake traffic which passed through the Detroit river in 1905 was about 58,000,000 tons, valued at about \$615,000,000. It is increasing annually with marvelous rapidity. The records for the year 1906, so far as they are made up, indicate that the number of tons which passed through the Detroit river in 1906 exceeded 65,000,000, valued at \$690,000,000. The lowering of the water surface has a very injurious effect upon this traffic, and upon that of the Welland and St. Lawrence canals. Chicago being one of the principal lake ports, there will be very few communities which will feel the injury more than she will.

(p) The cost of restoring the depth in the harbours of the Great Lakes and the channels between the lakes is estimated at \$10,000,000, and of restoring it in the Welland and St. Lawrence canals at \$2,500,000. This expenditure would not prevent very serious annoyance to the navigation interests during the execution of the remedial works, which would occupy several years. In Lake St. Clair navigation of the open lake would be replaced by that of an artificial channel or canal with submerged banks.

(q) The extension to the Calumet region of the method of sewage disposal already

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applied to the Chicago river is not necessary to preserve the health of Chicago, there being other and better methods available for the Calumet region. The final cost of these methods is somewhat greater than that of the one proposed, but the works can be developed as the population increases, and only a part of their cost need be incurred at present, while their greater efficiency justifies the increase of final cost.

(r) The diversion of 10,000 cubic feet of water per second at Chicago will render practicable a waterway to the Mississippi river, 14 feet deep. Any greater depth must be obtained by the abstraction of more water from Lake Michigan and at the expense of the navigation interests of the Great Lakes and of the St. Lawrence valley.

(s) The effect upon Niagara Falls of diverting water at Chicago is of secondary importance when considering the health of a great city and the navigation interests of the Great Lakes and of the St. Lawrence valley, but it is proper to note that the volume of the falls will be diminished by the full amount diverted at Chicago.

RECOMMENDATIONS.

41. The waters of Lake Michigan in the United States, the waters of Georgian Bay in Canada, and the waters of Lake Superior partly in the United States and partly in Canada all form sources of supply of the Great Lakes system, finding their way by the St. Lawrence to the sea. All are interdependent and there can be no diversion from any of them without injury to the whole system. By Article XXVI. of the treaty of 1871 it is provided that 'navigation of the River St. Lawrence, ascending and descending from the forty-fifth parallel of north latitude, where it ceases to form the boundary between the two countries, from, to, and into the sea, shall forever remain free and open for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain, or of the Dominion of Canada, not inconsistent with such privileges of free navigation.' It is desirable that in any treaty arrangement the waters of Lake Michigan, Georgian bay, and all other waters forming part of the Great Lakes system should be declared to be 'forever free and open for the purposes of commerce' to the citizens of the United States and the subjects of His Britannic Majesty, subject to any laws and regulations of either country not inconsistent with such privilege of free navigation.

42. The preservation of the levels of the Great Lakes is imperative. The interest of navigation in these waters is paramount, subject only to the right of use for domestic purposes, in which term is included necessary sanitary purposes. In our report of November 15, 1906, upon the application of the Minnesota Canal and Power Company to divert certain waters in Minnesota we recommended, among other things—'that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be (a) uses for necessary domestic and sanitary purposes; (b) service of locks for navigation purposes; (c) the right to navigate.'

It is our opinion that so far as international action is concerned a treaty provision of that kind is all that is required in this case. We accordingly renew our recommendation of November 15, 1906, just quoted.

43. A careful consideration of all the circumstances leads us to the conclusion that the diversion of 10,000 cubic feet per second through the Chicago river will, with proper treatment of the sewage from areas now sparsely occupied, provide for all the population which will ever be tributary to that river, and that the amount named will therefore suffice for the sanitary purposes of the city for all time. Incidentally it will provide for the largest navigable waterway from Lake Michigan to the Mississippi river, which has been considered by Congress.

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We therefore recommend that the Government of the United States prohibit the diversion of more than 10,000 cubic feet per second for the Chicago Drainage Canal.

All of which is respectfully submitted.

W. F. KING,

Chairman, Canadian Section.

O. H. ERNST,

*Brigadier-General, U. S. Army, retired,
Chairman, American Section.*

GEO. C. GIBBONS,

LOUIS COTE,

Members, Canadian Section.

GEORGE CLINTON,

E. E. HASKELL,

Members, American Section.

Attest: W. EDWARD WILSON, *Secretary, American Section.*

THOMAS CÔTÉ, *Secretary, Canadian Section.*

APPENDICES.

- A. Report dated January, 1887, to the mayor and city council of Chicago, of the commission appointed to examine the drainage and water supply.
- B.—Letter dated June 29, 1906, from Mr. Lyman E. Cooley, civil engineer, formerly chief assistant to the commission of 1887.
- C.—Statement of expenditures by sanitary district of Chicago to December 31, 1905.
- D.—Copies of all permits issued by the Secretary of War to the sanitary district of Chicago.
- E.—Joint resolution of Illinois legislature adopted May 27, 1889.
- F.—Report of Messrs. Rudolph Hering and George W. Fuller upon methods of sewage disposal available at Chicago.

APPENDIX A.

CHICAGO, January, 1887.

To the Honourable Mayor and City Council of the City of Chicago :

GENTLEMEN,—On January 27, 1886, your honourable body passed a resolution authorizing the creation of a drainage and water supply commission. After being amended, February 23, it read as follows:—

‘Whereas, pure water and scientific drainage are necessities of this community, and the people demand a system of water supply and drainage adequate to meet the requirements not only of the present, but of years to come, nor will any temporary expedient or makeshift satisfy them; and

‘Whereas, a thorough and permanent system of supplying pure water to our citizens and caring for the drainage of the municipality can not be paid for out of current taxation, therefore it is desired that a plan shall be devised and perfected before the next meeting of the legislature to the end that necessary legislation may be had.

‘For the purpose of carrying into effect the objects sought, there is recommended the appointment by the mayor of a commission to consist of one expert engineer, whose reputation is so high that his opinion and report will command the respect of the community, and with him one or two consulting engineers of like experience in engineer-

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ing and sanitary matters. The duty of this drainage and water supply commission, made up as above set forth, should be to consider all plans relating to drainage and water supply which may be brought to its attention; to make such examinations and investigations and surveys as may be deemed necessary; to collect all information bearing on this problem; to consider all recent developments in the matter of sewage disposal, and their application to our present and future needs; to consider and meet necessity of increasing our water supply and of protecting the same from contamination; to remedy our present inadequate methods of drainage and sewage disposal; to consider the relations of any system proposed to adjacent districts, and whether there may not be a union between the city and its suburbs to solve the great problem; to determine the great question as to the interest which the state and the United States may have in the disposal of sewage by way of the the Illinois river, and to devise plans to meet any objections thereto, if such a system shall be thought best; and in general to consider and report upon any and all things which relate to the matter of water supply and drainage of the city of Chicago.

‘The commission should report on the whole matter committed to it in the most full and comprehensive manner, with maps, plans, and diagrams complete, and accompany the report with estimates of the first cost and annual requirements for the maintenance of the system proposed.

‘The report of the commission should be made as early as practicable, and not later than the convening of the next session of the Illinois legislature in January, 1887.

‘In consideration of the foregoing, be it

‘Resolved, That the mayor be, and is hereby, authorized and directed to employ on behalf of the city one expert engineer of reputation and experience in engineering and sanitary matters, at a salary not to exceed \$10,000 per annum, and also to employ such consulting engineers, not exceeding two in number, as may seem necessary, and such Assistant Engineers as may be required, all to be paid according to services rendered, for the purpose of carrying out the objects set forth in the preamble hereto. For the fees of said assistant engineers and for all expenses connected with said work there shall be allowed not to exceed the sum of \$20,000. All fees, salaries, and expenses connected with said work shall not exceed in the aggregate the sum of \$30,000, and the same shall be paid from the water fund of the city upon vouchers audited by the mayor and city comptroller.’

In accordance with the terms expressed herein his honour Carter H. Harrison appointed Rudolph Hering as chief engineer, Benezette Williams and S. G. Artingstall as consulting engineers, who together should constitute a commission. Mr. Hering entered upon duty March 28, Mr. Williams, September 17, and Mr. Artingstall, December 21, 1886.

The investigation designated by the resolution was a formidable one, comprising no less a task than the consideration of the entire subject of the future water supply and drainage of Chicago. It appeared doubtful from the beginning that a report such as was demanded could be furnished within the specified time, for the simple reason, if for no other, that observations of the lake phenomena and of the flow of certain rivers should be extended over at least one year, covering four consecutive seasons, in order to draw satisfactory deductions.

But the large amount of work alone that was asked for made it impracticable to present a complete report in so short a time. It was expected, however, that results could be reached sufficient to indicate the character of legislation required to carry out any project that might be determined upon, and that therefore a preliminary report having this end in view could be made at the stated time, leaving to a later date the presentation of a report outlining the detailed features of the scheme recommended and embracing the minor results of the entire inquiry.

The present communication is to cover the ground indicated for the preliminary report, and besides containing the conclusions reached regarding the main features of the proposed project, it contains also a brief review of the work done during the past year and of what still remains to be done.

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The month of April was devoted to a general examination of the subject of the territory to be investigated, and of the various suggestions that had been made toward effecting a solution of the problem.

The examination disclosed the fact that the city is sometimes greatly suffering from the offensive condition of parts of the Chicago river and its branches, caused by the discharge of sewage into the same, and from the occasional contamination of its water supply, brought about by the discharge of the polluted contents of the river into the lake. It also disclosed the fact that almost every conceivable way of dealing with these questions had been suggested and in some forms applied during the past thirty years.

The problem therefore demands the attainment of two ends—the protection of the water supply and the removal of the river nuisance. As the water must be taken from the lake, it is evident that both its pollution and the objectionable condition of the rivers should be prevented by a better disposition of the sewage. It is, therefore, the latter question which constitutes the main object of this investigation.

Among the possible methods of getting rid of the Chicago sewage there are but three that have been deemed worthy of an extended consideration, namely: A discharge into Lake Michigan, a disposal upon land, and a discharge into the Des Plaines river. The preliminary work has, therefore, been confined to these three projects, and was classed as topographic, hydrographic, and miscellaneous.

At the time when the present commission began its labours the topographical work had already received some attention. Surveys were being made of the Des Plaines river from Bridgeport westward under the direction of Mr. Artingstall, city engineer. These surveys were continued, and have now been completed as far as Joliet. They include contours of the entire valley and borings to rock between Bridgeport and Lemont. In order to understand the hydrography of the Des Plaines Valley above the point where the Chicago sewage could be discharged into it, and also to ascertain the probable magnitude and effect of floods in the river, a survey was made of its bed as far north as Northfield township. To determine the area of the basin its entire divide was located. To ascertain the practicability of diverting the flood waters from the upper portion of the Des Plaines and North Branch watersheds directly into the lake, and thus avoiding the difficulties which would arise from their passing through the Chicago river, all feasible lines were surveyed. Finally, a few levels were taken of the area adjoining the city wherever no connected levels existed to show the general topographical features of the territory over which the future city will spread out and from which the drainage will require artificial removal.

The hydrographic work consisted in ascertaining the flow of the Des Plaines river, the rainfall upon its area, its flood discharges, the character of its bed, and the probable effect of discharging the Chicago sewage into it when diluted by a large and constant stream of water from the lake. It consisted, further, in examining the nature of the currents in the lake and in studying the rise and fall of its level, and in ascertaining the amount and character both of the sewage discharged into it and of the deposits in the river and lake in front of the city to determine the effects of the present sewage disposal.

Inquiries and surveys were made to show the feasibility of purifying the Chicago sewage by filtration on land. Land damages were carefully estimated for the different schemes; existing records were searched concerning borings and excavations made in and about the city, so that the practicability of certain lines of tunnels could be discovered; the probable growth of the city and its suburbs, as well as the probable distribution of the future population, received a careful attention, and, finally, a large number of data were compiled which pertain to the existing works of water supply and sewerage in Chicago and the adjoining towns.

In reporting the result thus far gained we will present them in the order most convenient for discussion, but before doing so will briefly describe the present manner and effect of the sewage disposal, as shown by this investigation.

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PRESENT SEWAGE DISPOSAL.

The sewage works of Chicago and suburbs have been planned on what is called the combined system, in which the sewers serve for the removal both of sewage and rain water. In the town of Evanston they empty into the lake. In the town of Lakeview they partly discharge into the lake and partly into the North Branch. From the north and west divisions and part of the south division of Chicago, the drainage enters the Chicago river and its branches, and from the remaining part of the south division it flows into the lake at three outlets, situated respectively at Twelfth, Twenty-second and Thirty-fifth streets. The sewers of Hyde Park discharge into the lake, excepting those of Pullman, where the sewage is disposed of on land. The town of Lake, including the stock yards district, drains into the south fork of the Chicago river.

When the sewage works of this city were designed, in 1856, by Mr. E. S. Cheshbrough, it was apprehended that ultimately some means would have to be found to change the water in the river from time to time or to keep the sewage entirely out of it. The first step toward improving the condition of the river was taken by deepening the Illinois and Michigan canal, so as to cause a current from the lake to the Des Plaines river at Lockport. The next step was the building of the Fullerton avenue conduit in order to produce a circulation in the North Branch; and the last step was the erection of the canal pumping works to increase the flow in the river, which had become greatly polluted.

The influence of these works is confined to the main river and its north and south branches. But the south fork of the latter, receiving a large amount of sewage from Chicago and the town of Lake, and charged with the waste from the Union Stock Yards and packing houses, has no artificial means for a circulation of its water, and as a consequence is in a condition of great filthiness.

The accompanying diagram* has been prepared to show the present pollution of the Chicago river and its branches during the time when all of their water is discharged into the canal by the Bridgeport pumps. On the left are shown the main river and the north branch, one above the other, their combined waters forming the south branch, and reaching Bridgeport on the right, where they are lifted into the canal.

At the latter point the south fork is shown as joining it. The shaded portions indicate the amount of sewage entering and passing the respective points, and the blank portions the lake water diluting it. The degree of dilution is shown by the relative areas. It diminishes in the north branch from Fullerton avenue to the south branch, and becomes still less toward Bridgeport, and finally receives the foul waters of the south fork.

The depth and character of sewage deposits in the river and harbour, as might be expected, vary considerably. They are not great in the track of the vessels, but increase towards the docks and quieter portions of the slips, where they reach a depth of from 1 to 4 feet. While the deposits in the channel are of a heavier kind, such as cinders, those in the docks are mostly a foul mass of decomposing organic matter. No form of life is found to exist above Clark street bridge as far north as Clybourn place and as far south as Ashland avenue. The effect of this condition of the river is to endanger the purity of the water supply whenever the river, with its accumulated deposits, flows into the lake, which occurs when the rain water that finds its way into the river exceeds the amount pumped into the canal. If this excess is great, as in the spring and occasionally in the summer months, the contamination of the lake is considerable, and must constantly increase.

From the foregoing it is seen that the present method of disposal of the sewage from Chicago and its suburbs is partly by discharging it into Lake Michigan, but mainly, except during floods, by discharging it into the Des Plaines river.

* Omitted ; printed in House Ex. Doc. No. 264, 51st Cong., 1st sess.

FUTURE POPULATION.

The first question which required an answer, and upon which many of the subsequent inquiries depended, was the population which it is economical and advisable to consider at present, and the extent of territory upon which such a population will be located.

The growth of Chicago has been frequently quoted as phenomenal. Estimates made thereof for various purposes have turned out to be rather under than over the actual result.

It is taken for granted that Chicago and its suburban towns will have to dispose of their sewage so that the water supply for the entire community residing near the lake from the south line of Hyde Park to the north line of Evanston will be guarded against pollution by the sewage from any one of its separate communities. For this purpose the whole populated area within the above limits is considered as forming one city with a common interest.

The growth of this metropolis was obtained partly from the United States census and partly from the school census of Cook county, which gave a record up to the summer of 1886. In order to forecast the probable ratio of the future increase it was desirable to compare this growth with that of other cities. By considering the ratio in increase elsewhere, and including the natural suburbs of each city, a fair and instructive basis of comparison was obtained; and by realizing the respective natural advantages for growth in each of the communities the probable ratio for Chicago was determined with a satisfactory degree of exactness.

The accompanying diagram shows the results of this comparison. It represents by curves the population of the largest cities in the country since 1790, not as usually quoted from the census, giving the inhabitants on certain arbitrary areas fixed by law, but as virtually making up the population of the respective municipalities, by including adjacent towns and natural suburbs, the only method which enables the true growth of the great cities to be recognized. For instance, the New York centre naturally includes Brooklyn, Jersey City, Hoboken, Newark, and other suburbs, and Chicago, the entire territory from Hyde Park to Evanston.

The diagram indicates that the character of growth of the different cities permits them to be divided into two distinct classes. Philadelphia, Boston, St. Louis and Cincinnati show very much the same character of increase, and represent by comparison the more conservative communities. New York and Chicago, on the other hand, while showing a remarkable resemblance to each other, form quite a contrast to the rest of the cities, and might be called the more progressive communities. The diagram finally indicates the time when the Chicago curve, which was the lowest one prior to 1864, intersected in turn those of St. Louis, Cincinnati, Boston, and there is a high degree of probability of its intersecting the Philadelphia curve in or before 1891—i.e., in four years from now—after which Chicago will be the second largest centre of population in America.

As it is not practicable in so young a city as Chicago to forecast a definite line of growth, it is preferred to give the probable maximum and the probable minimum between which the true line will most likely be contained. The minimum line represents a growth resembling that of New York, and the maximum line assumes the ratio of increase per decade to be constant instead of gradually decreasing as in most other cities. The result indicates that the population of Chicago and suburbs will be 2,500,000 between the years 1905 and 1915, or about three times the present population in eighteen to twenty-eight years.

In providing public works for large communities it must be borne in mind that it is economical to invest only such sums as will bring a return within a certain number of years, leaving expenditures for benefits that will be realized only at a later time to a later generation. This fact, together with the probable growth of Chicago, shows it to be economical and judicious at present to plan works sufficiently extensive to dispose of the sewage of not less than 2,500,000 inhabitants.

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In addition to the population the area that will be occupied by it has to be determined. While this is a far more difficult task, owing to the many accidental causes influencing the distribution of the population, it is possible nevertheless to outline the area sufficiently close for present purposes.

The future metropolis, with a population three times as great, will be distributed along the lake from South Chicago to Evanston, and will reach inland to the Blue Island Ridge in the south to the Des Plaines river in the centre, and to the higher parts of Niles Township in the north. Outside of these general limits, a more or less dense population will extend for some distance along the lines of railroad.*

As inferred above, it is proper to consider at this time the wants of the population that will reside upon this entire territory.

DISCHARGE OF THE SEWAGE INTO LAKE MICHIGAN.

To discharge the sewage from cities into comparatively large bodies of water is not only the usual, but often the best method for its disposal. Dilution and dispersion thoroughly expose it to the action of the oxygen contained in both the water and the superincumbent air; it is thereby gradually oxidized. Where the body of water is a large river with a strong current, the best conditions for such purification are found. Where it is a lake in which the circulation is slight and irregular, the efficacy of the method is less and depends for its success on the character of the currents and the relative amount of sewage to be discharged into it.

The hydrographic surveys of the lake made during the past season were therefore partly for the purpose of ascertaining, if possible, the laws governing the currents, so that we would know their effect in dispersing the sewage discharged into the lake. The trend of the shore currents was actually ascertained by daily recording the direction of spar buoys placed at the Chicago waterworks crib, at Michigan City and at St. Joseph. A large number of bottle floats were thrown into the lake at different points and different times for the same purpose. They were partly single surface floats and partly double, the lower one being placed at varying depths, according to the depth of the water. More than half of them have been picked up and returned, with place and date noted. The currents were also observed by means of large can buoys from an anchored tugboat at different points in the lake extending from Hyde Park to Evanston, about 6 miles from the shore. Two general lake trips were undertaken, one to St. Joseph and back to Grosse Point, and another one parallel with the shore around the head of the lake.

When the observations are completed and compiled in detail, some valuable information will be available for the question of water supply. Light will be thrown on the movement of the water under different winds and the sudden changes of temperature of the water at the crib and on the turbidness of the same.

The following results have a bearing on the question of sewage disposal: Where not affected by local conditions, the currents practically go with the winds in water of moderate depth and quickly respond to any change. In deep water also the surface currents run with the wind, but at the bottom and even at mid-depth the direction is usually different. The prevailing current along the shore of Cook County during the past summer has been observed to be toward the north, but it is possible that this result may be different during the winter months. In the open lake, wave action seems to be effective in preventing the permanent deposits down to a depth of about 60 feet; inside of the breakwater sewage deposits are found on the bottom.

The general deduction from these results is clear that, as no constant current exists which would carry the sewage away in one direction, it should be discharged into the lake at one end of the future city, while the water supply should be obtained as far away from it as practicable toward the other end, a conclusion which is being

* Here occurs a diagram showing the growth of several population centres in the United States, not here produced.

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acted upon in the other large lake cities. The proper place from which to bring the water would be opposite Grosse Point, and the sewage discharge should be east of Hyde Park. While it might be practicable to allow the sewage in its crude form to enter the lake under such conditions for many years, the necessity would arise later for clarifying it at least partially previous to its discharge. It could not be allowed to run into the river as at present, but the dry weather flow and a considerable amount of storm water would have to be intercepted and carried to the outfall through many miles of special conduits. This entire quantity would have to be raised by pumping in order to get sufficient head to empty into the lake, while the diluted sewage during storms, in excess of the capacity of the intercepting sewers, would be allowed to discharge directly into the river.

The water supply would have to be brought from Grosse Point in large conduits to the several pumping stations scattered over the city and its present suburbs. The circulation of the water in the Chicago river and branches would have to be maintained practically as it is at present, because the removal merely of the dry-weather flow of sewage would not altogether prevent its pollution.

DISPOSAL ON LAND.

We shall not at this time enter into a general discussion of the principles underlying land purification of sewage, or make historical references showing the success or ill success of the method as practised elsewhere. We will simply state that with good management under ordinarily favourable conditions a disposal on land proves satisfactory, so far as the purifications of the sewage is concerned, and that with proper conditions in the way of good markets and a favourable soil and climate, sewage farms can be operated on a large scale after the sewage is delivered upon the same without financial loss.

In speaking of a sewage farm of the magnitude required for the metropolitan area of Chicago, it is not understood as being land devoted primarily to the raising of crops, using the sewage only when and where it would most promote the growth of vegetation. The primary object would be the purification of the sewage on an area of land as small as could serve the purpose. Technically speaking, the sewage disposal would be by means of intermittent filtration rather than irrigation. To carry out such a scheme for Chicago involves the following:—

- (1) The acquirement of sufficient land suitable for the purpose.
- (2) A comprehensive system of intercepting and collecting sewers carrying the sewage to the farm.
- (3) Pumping works of a capacity to handle all the dry weather flow of sewage and a certain proportion of storm water.
- (4) A thorough underdrainage, levelling, and preparing of beds for the filtration areas.
- (5) A system of underground conduits and surface carriers for distributing the sewage over the ground, and a system of open ditches for removing the purified water to the nearest water courses.
- (6) Buildings, roads, and a complete farming outfit.
- (7) An organization for properly distributing the sewage, for carrying on the farming operations, for conducting the business of disposing of the crops in the best market.

In making estimates for the size of intercepting sewers, conduits, pumps and area of land required we have used as a basis a population of 2,500,000 people, with an average dry-weather sewage discharge of 150 gallons, or 20 cubic feet, per head daily, and made provision for storm water equivalent to one-fifth of an inch in twenty-four hours over all portions of the district now drained or likely to be drained by a combined system of sewers, allowing surplus water to escape into the rivers and lakes.

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The dry-weather flow of sewage would therefore be 50,000,000 cubic feet per day, and the maximum flow of storm water 65,000,000 cubic feet per day, making a total maximum discharge of 115,000,000 cubic feet.

From an examination of rainfall tables we conclude that the annual amount of storm water that would be carried off by such an intercepting system would range from 9 to 12 inches, an average of which in round numbers may be taken at 40,000 cubic feet per acre per annum over the area drained by a combined system of sewers. It is practicable, however, to exclude the storm water from the sewers over a large portion of the future city by adopting the separate system of sewage. The area north of the town of Jefferson and of the middle of Lakeview may be treated to advantage in this way, and also a large portion of Hyde Park, Lake Calumet, and other adjoining towns.

Assuming that the area which does not allow the storm water to be entirely excluded is 140 square miles, the average daily amount becomes 10,000,000 cubic feet, which gives, when added to the sewage, 60,000,000 cubic feet, or 24 cubic feet per head of population per day to be provided for on the farm.

As the amount of land required to purify sewage can only be determined by experience, and as this has been very limited in our own country, we are forced to rely mainly upon that of Europe. Without going into details at present, we will simply state that a fair consensus of this experience justifies us in the conclusion that from 10,000 to 15,000 acres of land would be required to dispose of the sewage from the entire metropolitan area.

The only available territory for sewage filtration in the neighbourhood of Chicago consists of two sandy ridges in the town of Thornton, extending across the state line into Indiana, and in a sandy ridge crossing the town of Niles. The soil is quite favourable, but the character of the surface is such that the necessary preparation to make it suitable for filtration beds would be comparatively expensive. An enormous cost is, however, represented by the fact that the sewage would have to be collected by large intercepting sewers, lifted altogether some 90 feet, and carried about 20 miles before reaching the farms. We therefore consider such a project entirely impracticable.

The land treatment can only be seriously thought of in connection with the sewage disposal from the smaller areas mentioned above and comprising the extreme northern and southern parts of the future metropolis. The drainage of parts of Evanston, Lake View, and Niles might be taken to the sandy ground in the latter town, and that of the Calumet region to the sandy ridges in Thornton, should this method be found most advantageous when compared with others.

The preliminary investigation made for this purpose consisted in an examination of the grounds, in the projection of a farm, and in an estimate of the cost of preparing the same and delivering the sewage to it by intercepting sewers and conduits.

DISCHARGE OF THE SEWAGE INTO THE DES PLAINES RIVER.

A third solution of the drainage problem is rendered practicable by the fact that the divide between Lake Michigan and the Mississippi valley lies about 10 miles west of Chicago, with so slight an elevation that it is not a difficult matter to carry the sewage from the city westward into the Des Plaines river, and thence into the Mississippi river. The method of disposal, as previously explained, is in fact mainly the present one, most of the sewage now being carried across the divide by the Illinois and Michigan canal.

There are two low depressions between the future metropolis and the Des Plaines river—the Mud Lake valley, with the present canal, and the Sag valley, west of Lake Calumet. Neither is more than 10 feet above the lake, nor do they present any engineering difficulties for canal construction. It is therefore quite feasible to carry all the drainage from the territory ultimately to be occupied by the metropolis, extending from Lake Calumet to Evanston, into the Mississippi valley through these depressions, avoid-

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ing thereby all possible lake pollution and permitting the supply of water to be drawn from any number of convenient points in front of the city.

The possibility of this solution was recognized as early as 1856 by Mr. E. S. Cheshbrough, and the first step toward its adoption was taken, as already mentioned, by turning the sewage into the Illinois and Michigan canal. Not until quite recently, however, has it become practicable to consider the construction of a special waterway for sewage removal, because when the population was smaller the expense of the undertaking was too great.

The sanitary requirements demand a flow of water large enough to dilute the sewage sufficiently to make it inoffensive along the river at all times. Beyond this, any increase in the size of the channel to provide for the storm water which naturally enters it should be kept at a minimum. A glance at the map and an examination of the ground show the possibility of diverting the greater part of the storm water from the metropolitan district without serious difficulty. Both branches of the Calumet river can be diverted west of the Indiana State line into Wolf lake, and thence into Lake Michigan. The Des Plaines river can have its flood waters diverted into the North Branch near the north line of the town of Jefferson, and the combined waters can be led from Bowmanville directly into the lake. Salt creek, a branch of the Des Plaines river, can readily be turned southwardly near Western Springs, through a watercourse known as Flag creek, at one time evidently its old bed, discharging into the Des Plaines opposite Sag, and thus reducing the necessary storm water capacity in the new channel between Sag and Summit.

In order to determine the probable quantity of flood water which can thus be excluded, it was necessary to ascertain the maximum flood discharges from all the watersheds in question. This requirement called for a gauging of Des Plaines, North Branch and Calumet rivers; a gauging of the rainfall, which is a measure of the stream flow; a survey of the watersheds and an examination of the river channels. It was also necessary to make a reconnaissance of all possible lines for diverting the Des Plaines, the North Branch, the Calumet rivers, and Salt Creek, and a survey of those which were most important.

The results indicate that each one of these diversions is both practical and economical. By adopting the 'separate system' of sewerage for the territory lying north of the proposed Bowmanville channel, the surface drainage from this territory can be safely turned into the lake.

A second branch of the investigation extends to the elements governing the proper size of the waterway from which a large proportion of the storm water has been excluded. The area still draining into it will consist largely of paved streets and roofs, allowing of no absorption and shedding the water rapidly. It requires a careful consideration to determine the maximum quantity of water that may enter the proposed channel, and for which an ample allowance must be made to prevent a back flow of the polluted water to the lake.

The proper degree of sewage pollution in the new channel demanded a careful investigation. When sewage is mingled with a sufficiently large quantity of water it not only becomes inoffensive, but readily finds the oxygen which gradually purifies it. When the surface is covered with ice a greater dilution is necessary for this purpose than at other times when there is a constant replenishment of oxygen from the air. The proposed waterway should, of course, provide immunity from offence at all times.

The information upon which definitely to decide this question will be given in the final report, as the data have not yet been all collected, owing to the necessity of making actual tests of the oxidization of the canal water under the ice, which is being done for the use of the commission by Dr. J. H. Rauch, secretary of the State Board of Health. The summer conditions are presented in his late report on the water supply and sewage disposal of Chicago. The result of these analyses will be compared with those of other streams that are also polluted with sewage in order to show the rate of oxidization with varying degrees of dilution and aeration.

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For the purpose of estimating the cost of the water channel we have assumed 3,600 square feet for the cross section and a velocity of the water 3 feet per second, or 2 miles per hour. This gives a discharge of 600,000 cubic feet of water per minute, or 24,000 cubic feet for each 100,000 persons, which we believe equal to the maximum requirements of a population of 2,500,000 people.

A third branch of the inquiry covers the selection of routes for the proposed canals.

Between Chicago and Summit three lines are practicable—one following the west fork and Ogden ditch, and another extending from the southwestern end of the south fork in a westerly direction to the Ogden ditch, and thence to Summit, and a third being an enlargement of the present canal. We are of the opinion that eventually both the first and second of these lines should be adopted, but that the second one should be built first in order to secure circulation in the south fork. From Summit westward the bed of the river and the present canal were the only lines to be considered. The best location has not yet been finally determined.

For the drainage of the Calumet region a simple inspection shows that a canal should start from the river at the southern point of Blue Island, and extend almost directly westward to the Des Plaines Valley at Sag.

A fourth branch of the inquiry relates to the study of such data as have reference to securing a proper circulation for the waterways within the city.

To throw light upon this point the variations of the lake level have been recorded since last spring by means of an automatic gauge indicating an almost continual fluctuation averaging several inches, and recurring at periods of about twenty minutes. During a low pressure of the atmosphere the amplitude of these oscillations increases, and not unfrequently reaches several feet. The accompanying diagram ^a shows the level of the lake on August 16, 1886, at a time when an area of low barometer passed over it. From 6.40 a.m. to 6.55 a.m.—that is, in fifteen minutes—the water fell 2 feet 10 inches.

A rising level causes an inflow to the river and drives the water of the latter into the slips, where it deposits a portion of its suspended sewage matter and becomes foul. A falling level reverses the flow, and the slips empty their foul water into the river and lake. During heavy fluctuations of the latter such as the one referred to above, it has been traced more than a mile in the direction of the crib.

As the proposed canal from Bowmanville to the lake will lower the water of the North Branch at this point to the lake level, provision must be made for its circulation. The size of the Fullerton avenue conduit is not sufficient to furnish the water required for a current in both directions, nor would such an arrangement be satisfactory or economical. It will be necessary to establish a flow toward the South Branch from the lake opposite Bowmanville in order to prevent a future lake pollution by the proposed channel. This can be accomplished by placing a lock in the North Branch at any point that may be found most desirable and raising the water at the same time about 1 foot. If such a lock is placed at Fullerton avenue the present pumping works, with slight modifications, can be utilized.

Finally, it must be mentioned that circulation can be secured in the proposed waterways of the Calumet region, into which the sewage is discharged, by a gravity flow from Lake Michigan into the Des Plaines Valley through Lake Calumet and the Sag. The detailed features of this project have not yet been wholly matured the estimates of cost being based on a channel having a capacity of 1,000 cubic feet per second.

COMPARISON OF PROJECTS.

In the foregoing we have outlined the main features of the only three feasible methods of disposing of the metropolitan sewage, and have given the results of the investigation reached to date. A general conclusion as to the preferable method may

^a Omitted; printed in House Ex. Doc. No. 264, 51st Cong., 1st sess.

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be given at present, and also an approximate estimate of cost. But we are not able as yet to give either conclusions or detailed statements of the probable expense regarding all parts of the proposed work, and must defer them until the final report.

In comparing the projects we will first mention their probable cost and then their relative advantages.

The discharge of the sewage into the lake from a population of 2,500,000 in the manner described above, including the extra expense, otherwise not necessary, of taking the water supply of Grosse Point, would cost at least \$37,000,000, with an annual expense for interest and operation of at least \$2,400,000. It would require an immediate investment of about \$20,000,000.

To dispose of the entire metropolitan sewage by filtration on land would require an investment of about \$58,000,000, with an annual expense of over \$3,000,000 for interest, pumping and maintenance, after deducting the profit from the sale of crops. It would be necessary to invest at once about \$34,000,000. Land disposal for the sewage from the Calumet region alone, with a future population of 300,000, would require an investment of about \$4,000,000 and an annual expense of at least \$250,000.

Finally, the cost of the Des Plaines project is approximately estimated as follows:

1. A channel from the South Fork to Joliet of the capacity heretofore given will cost between \$17,000,000 and \$21,000,000.
2. A diversion of the flood waters of the Des Plaines to the North Branch, and Salt Creek will cost between \$2,500,000 and \$2,800,000.
3. Pumping works and locks for the North Branch will cost about \$150,000.
4. A separate system of sewers to collect the sewage now discharged directly into the lake and to carry it into the river will cost about \$600,000.
5. A channel from Lake Calumet to Sag will cost between \$2,500,000 and \$3,000,000.
6. A diversion of the flood waters of the Calumet river will cost between \$350,000 and \$400,000.

The total cost of the Des Plaines drainage project would therefore be, for the main district, between \$20,250,000 and \$24,550,000; for the Calumet district, between \$2,850,000 and \$3,400,000. The annual cost, including interest, &c., is estimated at about \$1,300,000 per annum.

The pollution of the lake can be decreased and the present condition of the Chicago river, and particularly of the South Fork, can be improved by the immediate construction of the following works, which, with the exception of the pumping works at the South Fork discharging into the Illinois and Michigan canal, are all a part of the final plan.

1. Channels diverting the flood waters of the Des Plaines, North Branch, and Salt Creek, as described above.

2. A modification of the Fullerton avenue pumping station and the construction of locks for the purpose of getting circulation in the North Branch.

3. A separate system of sewers to collect the sewage now flowing into the lake from the south division and to discharge it into the South Fork.

4. A waterway extending from the western end of the South Fork to the Illinois and Michigan canal, with a new pumping station to promote circulation.

5. By raising the banks of the canal and by removing deposits this capacity can be increased 40 per cent at a small cost, and thus provide for a greater flow of water in the same.

The cost of the works comprised under these five items is estimated to be between \$5,000,000 and \$5,500,000. They could be finished in three years, and would greatly lessen the liability of polluting the water supply, while the sewage would be disposed of in the best practicable manner until the final completion of the Des Plaines project.

It therefore appears that this project is decidedly the least expensive one for the present as well as for the future.

Besides the economical advantage of the Des Plaines scheme, its superiority is

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still further emphasized by advantages of another kind. The proposed canal will, from its necessary dimensions and its regular discharge, produce a magnificent waterway between Chicago and the Mississippi river, suitable for the navigation of boats having as much as 2,000 tons burden. It will establish an available water power between Lockport and Marseilles fully twice as large as that of the Mississippi river at Minneapolis, which will be of great commercial value to the State. The Calumet region will be much enhanced in value by having a direct navigable channel to the Des Plaines river and by a lowering of the flood heights of Calumet lake and river. Within the city the water of the Chicago river and its South Branch will get a much better circulation if it flows by gravity than if it has to be pumped, the necessity for which would remain even if the sewage should be discharged through intercepting sewers, either into the lake or upon land. Upon either of the latter conditions an occasional overflow from the sewers into the river during heavy rains would be more objectionable than a constant discharge of sewage into a more rapidly flowing stream. Flood waters entering the lake by way of the Chicago river would carry into it much filthy matter, either suspended or deposited, notwithstanding the existence of intercepting sewers, but the proposed diversion of such waters before reaching the populated districts will for all time obviate this undesirable occurrence. Lowering the level of the North Branch at Bowmanville by its diversion to the lake will be equivalent to raising the low prairie extending toward Evanston and Niles and greatly benefit parts of these towns.

THE WATER SUPPLY.

In reaching the conclusion that the sewage of the city should be discharged into the Mississippi Valley the question of water supply is materially simplified, because the lake will then at all times furnish good water wherever intakes are desired for an extension of the works.

The preliminary inquiry made with a view to ascertain the main features of an increased supply comprised, first, a compilation of data concerning the existing works both in Chicago and its suburban towns, which were collected mainly through the courtesy of the respective authorities; and secondly, a study into the most economical method of distributing the water over the metropolitan area. The following is a brief description of the existing works:—

The present intake for the public water supply of Chicago is located in Lake Michigan about 2 miles from shore and the water is conducted to the city in two circular brick tunnels 5 and 7 feet in diameter. They extend parallel to each other under the bed of the lake, and 50 feet apart, to the north pumping works, where they are connected and where the 5-foot tunnel terminates. The 7-foot tunnel is continued under the city for a distance of 20,500 feet, to supply the west works, on Ashland avenue near Twenty-second street.

The tunnels from the source to the shore are built at a depth of 80 feet below city datum, or low water in the lake, and the 7-foot tunnel is continued on the same level for a distance of about 11,500 feet, where, to avoid rock excavation, it is inclined upward until, at the west pumping station, the top is but 21 feet below city datum. The economical capacity of the two tunnels is between 90,000,000 and 100,000,000 gallons per day, or less than the present average daily consumption of water. Their maximum capacity is reached when delivering about 150,000,000 gallons per day, which is now nearly equalled by the demand during the hours of greatest consumption, and at the present rate of increase it is estimated that during the summer of 1887 the maximum demand for water will be at the rate of 145,000,000 gallons per day; during 1888, 150,000,000 gallons per day; during 1889, 167,000,000 gallons per day; and in 1890, 180,000,000 gallons per day.

To provide against accident or obstruction from ice or other cause in the main tunnels, and to provide against an inadequate supply in the near future, which appeared inevitable, a new tunnel is in progress of construction. The intake is located

1,500 feet from shore, and connection is made with the other tunnels at the north pumping works.

The distribution of the water is effected by pumping it directly into the water mains at the north and west stations. At the north works the three tunnels are so arranged and constructed that any one of them can be emptied when desired for repairs or cleaning, and both the pumping stations still be supplied with water from the other tunnels. The total pumping capacity of this station is at present 67,000,000 gallons per day, but it will be increased to 91,000,000 gallons per day as soon as the new pumps now in process of erection are in operation.

The connections between the pumps, standpipes, and the distribution mains at these works have become so complex by the successive additions to the plant that an unnecessary loss of head is the consequence. As this can be remedied to some extent without great expense, we recommend that it be done at the first favourable opportunity. The station being on the shore of the lake, is not centrally located with reference to any part of the city, which renders it necessary to use a greater length of main pipe, with a consequent loss of pressure, to reach the consumers than would otherwise be the case. The total pumping capacity of the west side station is 60,000,000 gallons per day, and the connections between the pumps, standpipes, and mains are simple and effective, and the loss of pressure from this cause is a minimum. The location is better adapted to secure economical and satisfactory results than that of the north works, and with reference to additional pumping stations, which will later be necessary in other parts of the city, these works are well situated.

The following table compiled from the annual reports for 1884 and 1885 gives a detailed comparison of the cost of pumping at two stations, anthracite coal being used at the north side and good bituminous coal at the west side:

COST OF PUMPING 1,000,000 GALLONS 1 FOOT HIGH.

Nature of expenditure.	1884.		1885.	
	North side.	West side.	North side.	West side.
Salaries.....	\$ 0.01488	\$ 0.02022	\$ 0.01560	\$ 0.01667
Fuel.....	.05313	.02855	.04590	.02482
Lubricants.....	.00064	.00186	.00057	.00160
Miscellaneous.....	.00323	.00417	.00133	.00401
Total.....	.07188	.05480	0.06340	.4710

The hydraulic methods of the system are shown on the diagram of water pressures from a survey made in December, 1886. The pressures have all be reduced to a common height above city datum and to a uniform height of water at the works. That diagram shows a greater loss of head in the vicinity of the north side station than at the west side. This is accounted for by the complex arrangements heretofore mentioned, and also by the relatively small area of mains, being only 16½ square feet at the north side and over 21 square feet at the west side. Nearly equal quantities of water are pumped at each of the stations during the middle of the day.

The following table shows the pumping capacity of all the suburban towns having a public water supply, and the pressure ordinarily maintained at the works. With the exception of South Evanston, all take water from Lake Michigan.

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Locality.	Individual pump capacity.		Total pumping capacity per day.	Ordinary head at pump, in feet.
	Pumps.	Capacity per day.		
		Gallons.		
Hyde Park.....	2	3,000,000	18,000,000	103 to 150
Hyde Park.....	1	12,000,000		
Lake.....	2	4,000,000	12,000,000	100 to 190
Lake.....	2	2,000,000		
Lake View.....	1	5,000,000	10,000,000	92
Lake View.....	1	3,000,000		92
Lake View.....	1	2,000,000	3,000,000	92
Village of Evanston.....	1	3,000,000		
Total.....	11		43,000,000	

At the artesian well supplying the village of South Evanston there is a head of about 53 feet.

The pressure at different parts of the pipe system is very irregular. In Hyde Park it varies from 165 feet at the pumps to 10 or 12 feet at Forty-third street. In the town of Lake the average head at the town hall is reported about 10 feet, with 188 feet at the pumps. In Evanston, South Evanston, and Lake View the difference of head in various parts of the villages is not very great (a).

The following table gives a comparison of the consumption and cost of water in Chicago and the suburban towns:—

Locality.	Year.	Average head at pumps.	Average daily pumpage.	Cost per 1,000,000 gallons delivered.	Cost of pumpin 1,000,00 gallons 1 foot high.
Chicago (North side).....	1885	113	38,369,134	\$ 7 17	\$0.06034
Chicago (West side).....	1885	105	58,280,880	4 95	.04071
Evanston (village).....	1886	113	787,000	17 00	.15000
Lake View.....	1886		1,983,000	11 85	
Town of Lake.....	1886	163	7,292,023	8 80	.05400
Hyde Park.....	1886		3,410,000	8.92	

The second point of inquiry was a study into the most economical method of distributing the water over the metropolitan area. We will at present refer to it but very briefly, mentioning only such conclusions as pertain to the immediate demands and leaving a fuller discussion of the details of this important question to the final report.

The comparatively level area upon which the city is located, and the precticality of taking the water from the lake along the city front at any desired point, after the sewage has been diverted, permits the most economical distribution to be ascertained by mathematical investigation to a much greater degree of exactness than is usually possible.

It is found to be less expensive for the densely populated areas to have pumping stations about 2 or 3 miles apart, because the loss of head and cost of mains and pumping to obtain the least allowable pressure are thus reduced to a minimum. In planning new works this fact should be considered, and locations so selected that they will be advantageous for the future as well as for the present.

The localities which we believe to be most suitable for additional pumping stations are near Twelfth street, in the central part of the city; near the Union Stock Yards; near Humboldt Park, and near Fullerton and Racine avenues.

When it is considered that at the present time the pumps are delivering during the busy part of the day at the rate of 120,000,000 gallons in twenty-four hours, which

a Here appears a "diagram showing water pressure in the Chicago water pipes." Not here reproduced.

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is nearly the maximum capacity of all the machinery, and that even with this large consumption of water it is impossible in some parts of the city to obtain water in the second story of the buildings, it becomes evident that an increased supply is imperatively required, and being a work of years to build new tunnels, inlets, buildings, and machinery, the necessity of deciding upon the location of the new works as soon as possible is readily seen. The locality which is suffering most from the want of water is the business section and the south part of the city, the lowest pressure extending from Twelfth street to the city limits. It will become necessary in the future to have two stations in this territory, one between Harrison and Twelfth streets and the other to be somewhere east of the Union Stock Yards. We are strongly of the opinion that of the two stations it will be advisable and most advantageous to build the one north of Twelfth street first, for the following reasons:

1. It will require a shorter tunnel from the lake to the proposed station and less expenditure for main discharge pipes to connect with the present system than would be the case with the proposed southern station. This is equivalent to less cost and a saving of time in construction.

2. If the southern station is built first it will require mains of larger capacity leading toward the city than will be ultimately necessary when the central station is built.

3. The location recommended is near the centre of the greatest consumption of water, and will be a gain not only in obtaining greater pressure in the business district, but in removing the cause for complaint on the south side by increasing the pressure so that the water will flow to the upper floors of the highest dwellings.

4. All other parts of the city will gain by the construction in this location, as the north and west works will be relieved of the enormous drain upon them to supply water for the business part of the city. They will be better able to give a good head on the north and west sides, where the population is increasing very rapidly, and which will very soon be in the same unsatisfactory condition as now obtains in the southern end of the city, unless relief is afforded in the manner indicated.

The other pumping stations will gradually become necessary as the population increases, and for a population of 2,500,000 there will be a need for a total combined capacity of 375,000,000 gallons to provide for a daily consumption of 150 gallons per head. With several intakes and tunnels the danger from stoppage of the water supply by ice or accident will be reduced to a minimum, as it is not probable that more than one of them would be so endangered at the same time.

We believe that a submerged intake will afford a more reliable and safer structure so far as injury from passing vessels and stoppage by ice are concerned than a structure projecting above the water.

With the sewage kept out of the lake there is no need of locating the intake farther than 2 miles from the shore, where water can be obtained sufficiently free from suspended earthy matter, and where a depth of about 30 feet is generally found, which is the least depth desirable for a submerged inlet.

After presenting the results thus far gained, indicating the general solution of the Chicago drainage and water-supply problem, it remains to point out certain facts which may be useful in discussing some of the legal measures required to carry out the proposed work. We desire to state that in order to reach the best results it is imperative to have all the main drainage works, such as intercepting sewers, waterways, and pumping stations, executed and maintained under a single management. It would be economical also to design and operate the main works of supplying water to the entire metropolitan area on a uniform plan and under one management, for the same reason that it is economical to keep the north and west side pumping works under one control, thus giving facilities as far as practicable for a supply proportioned to the demand to the entire metropolitan area, including the towns not bordering on the lake. We do not wish to imply, however, that such a general authority need necessarily extend further than to the construction and maintenance of the tunnels and conduits furnishing water to the respective pumping works.

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Regarding the limits for metropolitan drainage, the investigation has shown, as already indicated, that topographical conditions clearly define two districts for the future metropolis. The main district extends from the line of Eighty-seventh street on the south to the north line of Evanston and from the lake westward to the Des Plaines river. Its sewage is collected into one channel and discharged into the Des Plaines valley at Summit. The Calumet district extends over the natural drainage area of Calumet lake and river south of Eighty-seventh street, and has its outfall channel running from Blue Island to Sag.

The final report will contain several maps, showing certain features of the metropolitan area, namely, the distribution of the population in 1886, the existing works and main distribution pipes for water supply, and the existing main sewerage works and 5-foot contour lines over nearly the entire area. It will also contain maps and profiles of the proposed waterways and storm-water-diversion channels mentioned in the present report, and a map showing the lines of the main collecting and intercepting sewers of the proposed drainage districts, and also the lines of new tunnels and the general distribution of the water supply.

In carrying on the present investigation its various branches are placed in charge of the following gentlemen, of whose ability and industry we desire to make special mention: Mr. L. E. Cooley, principal assistant, had special charge of the hydrographic work; Mr. Charles H. Swan, of the sewage disposal on land; Mr. Francis Murphy, of the topographical work;) Mr. O. Guthrie, of the river pollution, land damages, etc., and Mr. T. T. Johnson, of the water supply, sewerage, and miscellaneous work.

Respectfully submitted.

RUDOLPH HERING,
Chief Engineer.

BENEZETT WILLIAMS,
SAMUEL G. ARLINGSTALL,
Consulting Engineers.

APPENDIX B.

CHICAGO, June 29, 1906.

DEAR GENERAL.—On May 28 I replied at length to your inquiries of May 26 concerning the final report of the drainage and water supply commission and the disposition of the materials which had been collected. Under date of May 31 you now ask for—

‘The sanitary authority upon which rests the requirement of the Illinois State law that 20,000 cubic feet per minute must be diverted into the Chicago Drainage Canal for every 100,000 inhabitants.’

And again—

‘How much water is really required to dilute the sewage?’

The proper answer to your questions involves a review of the considerations which determines the ratio of dilution in the sanitary district law and the justification for the same. I have therefore delayed this answer in order to consult original documents and memoranda. I have not undertaken to refer exhaustively to my records, as I am pressed for time, and my memory is entirely clear upon the essential facts.

The essence of the law is contained in section 20 and 23 of ‘An Act to create sanitary districts and to remove obstructions in the Des Plaines and Illinois rivers’ (passed May 29, 1889, in force July 1, 1889). Section 20 states: ‘Any channel or outlet * * * shall be of sufficient size and capacity to produce a continuous flow of water of at least 200 cubic feet per minute for each 1,000 of the population of the district drained thereby, and the same shall be kept and maintained of such size and in such condition that the water thereof will be neither offensive or injurious to the health of the people in this state.’ Section 23 states: ‘Such channel shall be made and kept of such size and in such condition that it will produce and maintain at

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all times a continuous flow of not less than 20,000 cubic feet of water per minute for each 100,000 of the population of such district.'

Section 23 states further : 'Such channel shall be constructed of sufficient size and capacity to produce and maintain at all times a continuous flow of not less than 300,000 cubic feet of water per minute, * * * and if any portion of any such channel shall be cut through a territory with a rocky stratum * * * such portion of said channel shall have double the flowing capacity above provided for.'

You will see that the law insists on a sanitary condition, and that the flow of water shall be continuous (at all times), and that the minimum dilution shall be (not less than) 20,000 cubic feet of water per minute for each 100,000 people. This indicates that the general assembly did not regard the ratio of dilution as a positive determination, and this accords with the facts. You will note further that the channel was to be cut through the rock with a minimum capacity of 600,000 cubic feet per minute, and that the channel in the clay was to be subject to progressive enlargement from a capacity of 300,000 cubic feet per minute with the growth of population above 1,500,000.

As a matter of fact, the rocky stratum extended from Lockport to Summit, and the channel was actually constructed of the larger capacity, leaving only 7.76 miles between Summit and the waters of the Chicago river for future enlargement. When the district was opened, January 17, 1900, the population of the district exceeded 1,500,000 and was, in fact, 1,637,972 by the federal census of 1900. By Act of the general assembly in 1903 the district was enlarged, and the population by census, within the new boundaries was 1,775,596.

I had everything to do in determining the prime essentials of the sanitary district law above quoted. I projected the work in its substantial outlines in a report which I drafted for the committee of the Citizens' Association in September, 1885. (Ossion Guthrie, Dr. Frank Reilly, and Lyman E. Cooley were a subcommittee to examine the situation and report.) As chief assistant to the Drainage and Water Supply Commission in 1886-87, I had charge, among other things, of the canal solution. I was consulting engineer to the State Board of Health in 1887-1889, and again in 1891, while its elaborate chemical investigation of the stream between Lake Michigan and St. Louis was under way. I was consulting engineer to the joint committee of the legislature (Mayor of Chicago, ex-officio, chairman) that framed the sanitary district Act, and as such determined the features of the law referred to. I later represented before the general assembly the several organizations of Chicago which were engaged in promoting legislation.

The state of our information in 1887 in regard to dilution and the capacity of channel required is discussed at some length in my testimony of April 7, 1887, before the joint committee of the general assembly. A few hundred copies of this were printed, but I do not know where an extra copy is to be had. I refer to this especially because it is the only published matter of that period after the preliminary report. I will also refer you to an elaborate paper which discusses the subject-matter, read on June 10, 1896, before the National Conference of State Boards of Health at Chicago. This was published by the secretary at Columbus, Ohio, and is hard to get. There were, of course, many fugitive and fragmentary discussions not considered worthy of preservation.

You will note in the preliminary report and in later testimony, that the Drainage and Water Supply Commission refers to a dilution of 24,000 cubic feet per minute as ample for a sanitary condition, and I believe that Mr. Hering, the chief of that commission, has stated that was his personal view of the requirements. As a matter of fact, the capacity of the channel was fixed at that time at 600,000 feet as required to remove the flood water from some 420 square miles of territory (after the diversion of the upper Des Plaines river), and prevent the same from backing into the lake. The basis of population used in considering land disposal and other alternative solutions proposed was 2,500,000, and this figure was applied to the proposed channel capacity,

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giving the ratio of 24,000 cubic feet per minute for each 100,000 people as above stated. At that time only preliminary consideration had been given to the question of dilution, as the chief force of the investigation had been applied to other alternative solutions.

I think it is also in evidence before the joint committee of the general assembly in 1887, by Doctor Rauch, secretary of the State Board of Health, that 14,000 cubic feet per minute would be sufficient. Doctor Rauch had undertaken an investigation of the subject preliminary to the elaborate studies of 1888-89. After the adjournment of the legislature and the failure of the Hurd Bill in 1887, little further attention was given to the matter until it was taken up by the special committee appointed to frame a law and report to the next general assembly.

This committee had several hearings, and developed much diversity of opinion. Personal opinions ranged from 14,000 feet per minute to 30,000 feet, and some wished to leave the matter entirely open. As no agreement could be reached, the whole subject was referred to the Consulting Engineer late in 1888, and after a painstaking investigation, he reported, and the results were embodied in the draft of the Bill and subsequently became law.

The data available are referred to as follows :—

‘Special investigations of the filth-producing industries of Chicago, and an elaborate investigation of the Chicago river and branches in the autumn of 1886, and after the flood of 1887, also the Illinois and Michigan canal ; a careful investigation of the history and condition of sewage in the Des Plaines and Illinois rivers for the fifteen years prior to 1887, between Joliet and La Salle ; the chemical investigations by the State Board of Health, over the route from Lake Michigan to the city of St. Louis, and of tributary streams, and a special investigation of the conditions produced by the distillers at Peoria and Pekin.’

The above data were probably more ample than had ever been brought before to the consideration of a similar problem. In addition, there were the following documents : Reports on the condition of the Seine at and below Paris ; reports on the sewage-disposal works at Berlin, then being inaugurated ; three reports by parliamentary commissions on river pollution in Great Britain ; reports on pollution of streams by the State Board of Health of Massachusetts ; reports by Doctor Chandler on the pollution of the Passaic river, New Jersey.

In addition, the consulting engineer had made special notes on the low water condition of the Ohio river and of the Upper Mississippi river, and on several other streams, in comparison with population.

The general result arrived at was that 14,000 cubic feet per minute would be adequate for a normal city population such as usually obtained in New England and in Europe, but that this ratio should be increased about 50 per cent on account of the special industries characteristic of Chicago and the quality of her site—flat topography, with impermeable subsoil. At that time—and we still have great industries based on animal and other organic products—the wastes coming from the stock yards and rendering establishments alone were estimated as the sewage equivalent of a normal city of 700,000 people. Every effort had been made, and is still being made, to utilize these organic wastes, and great progress had been made in the previous twenty years, but nevertheless it was thought wise to provide sufficiently for all conditions rather than subject any industry to special burdens. These considerations raised the dilution ratio to 20,000 cubic feet per minute as a minimum, and it was so recommended.

At that time we had distilleries in Chicago which were serious offenders, but they have since closed down. I examined the distilleries at Peoria in 1891, when 40,000 head of cattle were fed on the slops, and I found that the fish were destroyed for 24 miles down the river in the lower water season. It was noted that the conditions were worse when the raw slops were run directly into the river, as the cattle were not then

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present to reduce the decomposition by several stages. In this industry I understand that these wastes are now evaporated and pressed into cake and sold for stock food.

In the rendering business there is a highly concentrated effluent from the tanks, which would resemble consommé soup if it were filtered and deodorized, and this has defied all chemical science for its salvation. Hopes were entertained of converting it into commercial ammonia by destructive distillation, but this did not prove practicable on a commercial scale. I believe that sometime these valuable wastes will be commercially utilized, and when this is done a great burden will be taken off the Chicago Drainage Canal. It seemed to be that if it was not possible to make an economic use of these concentrated effluents, the profitable disposal of household sewage with the enormous volumes of water used in American cities was absolutely hopeless. At that time the sentiment of sanitarians was very strongly against what we proposed as a barbarism. The experience of nearly twenty years since has fully borne out the non-economic character of sewage-disposal works, and the Chicago solution has come to be accepted as rational where the conditions permit.

I was not satisfied with our data in regard to the stock-yards district, and when chief engineer of the sanitary district in 1890 I undertook a special chemical investigation, continued over a period of time, of every outfall entering the South Fork. The work was completed, but I ceased to be chief engineer before the results were fully worked out. At the same time I made a continued series of chemical analyses of the Illinois and Michigan canal, which was then being operated to a capacity of over 50,000 cubic feet per minute. These investigations cost some \$6,000. I became satisfied that I had not overestimated the special source of filth. It was my intention to carry the inquiry over the entire city and do what had never been done before—ascertain the sewage of a great municipality as a whole. If I had had my way in the matter we would have had more positive data as to the sewage equivalent and the volume of Lake Michigan water required. Our boards of trustees have not since encouraged the resumption of any such work, and indeed it has been regarded as needless by those in authority after the sanitary-district law had been passed and the work actually entered upon.

No extended investigations were again undertaken until the biological and chemical examinations of 1899 and 1900 were made by the co-operation of the health department of the city of Chicago, the Chicago University, and the University of Illinois.

This investigation was instigated by Dr. Frank W. Reilly, then and now assistant health commissioner of Chicago, after consultation with the writer. Doctor Reilly was Assistant Secretary of the State board of health during the investigations of 1881-1885, and in 1886 collated the results of Prof. J. H. Long's chemical examinations of the contents of the Illinois and Michigan canal and of the Illinois river and its tributaries as far south as Peoria. These examinations were projected by Dr. J. H. Rauch, Secretary of the State board, and were directly supervised by Doctor Reilly. His study and collation of Professor Long's analyses demonstrated that all traces of Chicago sewage pollution disappeared in a flow of 48 miles from its source—that is, between Bridgeport at the entrance of the Illinois and Michigan canal and the town of Channahon on the Des Plaines river, after this stream had received the discharge from the canal. This demonstration completely upset the time-honoured dictum of previous water analyses 'that no river on earth is long enough to purify itself after it has become contaminated with organic wastes.' Six years later, in 1892, Pottenkofer fully corroborated Doctor Reilly's demonstration.

Doctor Reilly and myself were associated in all the early promotion of the sanitary project, and he is the only person that I know upon whom you can call for a history of the subject-matter of this letter.

The biological examinations were entirely confirmatory of the results of the investigations of 1888-89, but have the merit of less confusion in interpretation. The State board of health has since recompiled and extended the results of its steam examinations and published a report in 1903. The University of Illinois has been making

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for several years past a biological investigation of the waters of the Illinois river, but with no special reference to the matters under consideration. I do not refer to data of an ex parte character gathered in the Chicago-St. Louis suit recently decided by the United States Supreme Court.

None of this later material nor the added experience and reflection of nearly twenty years has changed my mind in regard to the ratio of dilution as given in 1888 and incorporated in the sanitary district law. I do not think I could make a better determination at this time. I feel bound to say, however, that we have not yet had the final demonstration of experience. We shall not positively know until the intercepting sewer system is completed and in operation, the South Fork in active circulation, and also the North Branch, so that the canal receives the entire output of the city north of Eighty-seventh street in a comparatively fresh condition. I have been apprehensive that these contributions would be made before the Chicago river is sufficiently improved to furnish the necessary volume of water to promptly dilute the same. The analyses show a higher ratio per capita for chlorine and nitrogen, but this was anticipated. They also show a large proportion down the old canal, which, owing to the situation of its inlet, receives largely the output of the South Fork, but this was also anticipated. The evidence as to chlorine is to be taken with caution on account of the large use of salt in many of our industries, but the indications are that Chicago sewage may be even richer than I had presumed in comparison with the sewage of normal cities. I have no forebodings, however, other than as to the policy which may be pursued by the authorities of the sanitary district. Based on the advice of the consulting engineer the law is abundantly cautious in stating the ratio of dilution and the capacity of channel as minimums, and in insisting on a continuous flow, but unhappily there has been a disposition in many quarters to interpret these minimum requirements as maximums.

You will find in the testimony of 1887 and the paper before the National Conference of State Boards of Health in 1896, persistent reference to the necessity of maintaining the flow in the winter time. The investigations show clearly that the sewage travels farther down the stream in the winter season and is more dangerous to fish life when the oxygen cannot be renewed owing to an ice cover. The necessity for dilution is then paramount. In the original studies of an economic channel, made under my direction, first by William A. Lydon in 1886-87, and later by Thomas T. Johnston in 1890-91, the carrying capacity of a channel covered by ice was fully considered. On the present channel the capacity will be reduced by nearly 40 per cent, or to something over 60 per cent of the capacity of an open channel.

In making the studies for the main channel we adopted the most conservative coefficients. The channel depth was made nominally 22 feet, with an allowance of over 2 feet for fall between the lake and the head of the channel at Robey street, but it was understood that any proper improvement of the Chicago river and by other inlets would give a depth of 24 feet or more. The channel itself was made of better character than originally anticipated, owing to the use of the channeling machine. The effect has been to give a channel of nearly 40 per cent greater capacity than the minimum stated in the law. It was my hope and intention to produce a channel 30 feet deep, with a capacity of 1,000,000 feet, but I was not able to reach farther than I have stated.

Under the original theory the channel is not sufficient even now to carry 600,000 feet of water per minute under an ice cover. It has been ingeniously answered that this objection could be removed by the use of ice-boats, but I have a mental resistance to all solutions of sanitary problems that are not automatic in action, for sooner or later they go awry, to the prejudice of the public health.

It is fair to say, however, that thus far little ice has formed upon the main channel and that the flow has been little interfered with from this cause. This has been attributed to the large volumes of warm water from households and from manufacturing plants, and it is supposed also that active sewage decomposition may have something to do with it, and, further, that a surface film of oleaginous matter may afford some protection. Perhaps these explanations are after the facts, and therefore speculative.

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Whatever may be the cause, the effects should be relatively less when the channel shall be carrying the full volume. And, again, the grand law of average will give us more severe winters than we have been having since the channel was opened.

The estimates of the carrying capacity of the main channel are based as follows (report of expert commission; see proceedings of board of trustees of sanitary district, June 19, 1901, p. 7248):

‘Within the past two weeks the results of special observations made since this commission was organized, and other relevant data, has enabled an approximate determination of coefficients by which to determine the capacity of the main channel under the conditions specified. To determine these matters finally, however, requires a special set of observations under better weather conditions and with the canal operated for this purpose.’

The expert commission of 1901 estimated the capacity of the channel on a depth of 24.4 feet at Willow Springs, at 836,280 cubic feet per minute, in conjunction with a radical improvement of the Chicago river such as would furnish the entire supply of water without detriment to navigation. The same commission estimated the capacity on a depth of 24.2 feet at Willow Springs, at 827,040 cubic feet per minute in conjunction with a moderate improvement of the Chicago river north of Sixteenth street and an inlet direct to the lake adjacent to Sixteenth street on the south. In both cases the lake was assumed at Chicago datum, or low water of 1847. Both of these treatments were in harmony with the theory of the law and the original project.

The sanitary district has adopted, at least for the present, a channel through the Chicago river 200 feet wide, which the expert commission estimated would carry 390,000 feet of water per minute without detriment to navigation. I understand that it is expected to feed to the channel 600,000 feet through the Chicago river and the Thirty-ninth street conduit, and that one-fifth of this is to come by way of the conduit and the South Fork. I understand further that it is proposed to construct a channel from the Calumet region through the Sag, with a capacity of some 240,000 feet of water per minute. The total is 840,000 per minute, or the 14,000 feet per second which has been mentioned in the hearings at Washington and before your commission.

You will note in the testimony of 1887 that the consideration which originally fixed the channel at a capacity of 600,000 cubic feet per minute, was the flood volume from an area of 420 square miles. Assuming the channel to have a capacity of 840,000 cubic feet per minute, the flood equivalent would represent a territory of not over 700 square miles. To add more territory is sure to result at some time in the backing of the waters into the lake. Sewage pollution is to be regarded as most dangerous when the sewage is carried out in a fresh condition during floods and when the city is virtually taking a bath, and it was such eruptions of flood waters from the populated area which the drainage and water supply commission sought particularly to avoid.

I am therefore strenuously opposed to all propositions which propose to add unlimited territory to the present channel, and which propose in any manner to sacrifice part of its capacity in the carrying of floods from upland and rural territory. All the great filth-producing industries and the great population is now tributary, and will so remain, to the Chicago river, its branches, and the main channel; and I do not think that the provision which has been made for this territory is more ample than should have been provided for a reasonable future growth. The capacity on the present scale of minimum dilution, presuming it to be sufficient, is the equivalent of a population of 4,200,000. This may not actually be realized, but I feel sure that the progressive saving of wastes will eventually reduce the per capita output of sewage to more nearly the normal for other cities. We know that such utilization has already taken place in connection with the distilleries. We also have the police power, and can compel the care of specific sources of nuisance when necessity requires; but as already remarked, such a policy in connection with our great industries has not been considered wise.

I anticipate, therefore, that as conditions develop in the future, the channel may

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prove sufficient for five or six millions of people, provided the original plans can be carried out in their integrity. That means, however, that the capacity of the main channel shall be reserved substantially (and it has been planned and constructed on that idea) for the territory of the original district, and that only such provision shall be made for outlying territory as the actual necessities of its people require. If we study the relative growth of population and the character of the industrial development in such outlying territories, we shall be persuaded that such a policy will do no injustice and will conserve the sanitary purpose in the highest degree.

What is to be the future population of Chicago, no man can foresee. I think we may rest for the present on an assumption of five to six million people. In laying out the main channel its tangents were made parallel to and at a fixed distance from the Illinois and Michigan canal where the same was possible. The idea under this location was that the old canal would maintain the reservation for future use, and that the time might come when another canal alongside would be desirable. My thought in this matter was not so much an ultimate thought on the sanitary question as it was that we might wish to carry more water to the Illinois river in the interest of deeper navigation. If any such proposition is considered beyond the provision which has already been made, the whole continent should join, and we may dismiss it from present consideration. I do believe, however, that the time will come when public opinion on this continent will be sufficiently broad to make the best use possible of the waters of the Great Lakes, in the interest of the deepest possible navigation from the Gulf of St. Lawrence to the Gulf of Mexico, and I do believe that the project which Chicago has so happily inaugurated as the incident of a sanitary necessity, which will come to be looked upon as a monumental foresight.

I think I have covered the subject-matters of your inquiry. If you wish the documents which I have especially referred to, I will loan them to you, as I do not know where duplicates are to be had.

Yours very respectfully,

LYMAN E. COOLEY.

General O. H. ERNEST,

Chairman of American Section

International Waterways Commission, Washington, D.C.

APPENDIX C.

SUMMARY of net receipts and expenditures, sanitary district of Chicago, from organization to December 31, 1905.

Receipts.

Taxes collected for general purposes.. . . .	\$30,712,708 65	
Taxes collected for water-power development.. .	2,014,730 57	
		<hr/>
		\$32,727,439 22
Bond account (bonds outstanding)—		
First issue.. . . .	\$ 700,000 00	
Second issue	1,200,000 00	
Third issue.. . . .	1,350,000 00	
Fourth issue.. . . .	1,800,000 00	
Fifth issue...	400,000 00	
Sixth issue.. . . .	440,000 00	
Seventh issue...	200,000 00	

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Eighth issue	190,000 00	
Ninth issue...	700,000 00	
Tenth issue...	750,000 00	
Eleventh issue...	1,875,000 00	
Twelfth issue...	1,600,000 00	
Thirteenth issue...	1,275,000 00	
Fourteenth issue....	1,350,000 00	
Fifteenth issue...	1,350,000 00	
Sixteenth issue...	2,000,000 00	
		17,180,000 00
Interest on bank balances...		362,785 73
Tax levy, 1896 (warrants outstanding)...		5,212 91
Dock and land improvement and rental account (rent of land)		40,123 78
American Crushed Stone Company...		1,000 00
Western Stone Company...		3,278 00
Total receipts...		50,319,839 64

Expenditures.

Right of way...		\$ 6,983,944 14
River diversion construction...	\$ 1,000,186 38	
Bridge construction, river diversion...	142,486 20	
Main channel construction...	18,547,408 95	
Bridge construction, main channel...	1,978,536 38	
Controlling works, Lockport...	331,253 65	
Bridge construction, controlling works...	7,873 35	
Joliet project...	1,309,063 46	
Bridge construction, Joliet project...	271,351 16	
Chicago river, dredging, docking, &c...	2,027,221 78	
Bridge construction, Chicago river...	2,498,383 03	
Illinois and Michigan canal improvement at Bridgeport....	77,016 08	
Thirty-ninth street pumping station...	211,604 85	
Improvement of Kampsville and La Grange dams...	16,920 27	
Raising roadway of Brandon's bridge...	5,882 68	
		28,425,188 22
Water-power development	\$ 1,346,085 92	
Bridge construction, water-power development.	112,362 44	
		\$ 1,458,448 36
Capitalization and maintenance of bridges....	403,354 60	
Maintenance of highway bridge	12,613 89	
Maintenance account...	164,775 95	
		580,744 44
Interest on bonds...	6,821,647 58	
Interest on tax warrants...	468,453 69	
		7,290,101 27
Taxes on land—		
Cook county...	3,248 19	
Dupage county...	1,209 07	
Will county...	27,310 28	
		31,767 54

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Engineering department..	2,064,007 21	
Engineering department, water-power develop- ment....	97,778 20	
Clerical department..	173,361 87	
Law department..	1,031,154 12	
Treasury department..	41,832 39	
Police department..	400,160 69	
General account...	867,944 19	
		4,685,238 67
City of Chicago..		14,079 20
Land damages..		76,331 84
Marine damages..		9,647 32
Personal injuries account..		4,087 50
Bridgeport pumping works....		90,388 80
Special commission, Chicago Drainage canal...		33,075 97
Telephone line...		12,292 13
Telephone line repair account...		104 00
Weir, McKechney & Co...		22,118 14
E. D. Smith & Co...		2,400 00
		599,882 10
Total expenditures..		49,719,957 54
Emergency funds in hands of department officials \$	10,400 00	
Due from F. M. Blount, treasurer (deposit in National Bank of Illinois)....	22,043 48	
Due from John J. Hanberg, county collector..	45,727 38	
Due from collector, town of Niles.. . . .	1,660 32	
Balance in hands of C. L. Hutchinson, treas- urer, December 31, 1905.. . . .	520,050 92	
		599,882 10
		50,319,839 64

APPENDIX D.

[Permit of July 3, 1896.]

4554.]

IMPROVEMENT OF CHICAGO RIVER.

July 3, 1896.

SIR,—I have the honour to acknowledge the receipt of your letter of 16th ultimo, requesting permission to make certain changes in the capacity of the channel of the Chicago river for drainage purposes at points indicated on the map accompanying the application, and in reply beg to say that upon investigation it is found that the permission requested can be granted upon the following conditions:—

1. That while the general plan is approved, the sanitary district of Chicago must furnish plans in triplicate on an enlarged scale showing each proposed new bridge, each by-pass, and each new dock or wharf proposed to be built, in order that the Secretary of War may act intelligently in each case.

2. That this authority shall not be interpreted as approval of the plans of the sanitary district of Chicago to introduce a current into Chicago river. This latter proposition must hereafter be submitted for consideration.

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3. That it will not cover obstructions to navigation by reason of this work while in progress or when completed.

4. That the United States shall not be put to expense by reason of this work.

5. That this authority will expire by limitation in two years from date unless extended.

Very respectfully,

JOSEPH B. DOE,

Acting Secretary of War.

B. A. ECKHART, Esq.,

President the Sanitary District of Chicago, Rialto Building, Chicago, Ill.

[Permit of May 8, 1899.]

Whereas, by section 10 of an Act of Congress, approved March 3, 1899, entitled 'An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbours, and for other purposes,' it is provided that it shall not be lawful to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same ;

And whereas the sanitary district of Chicago, a municipal corporation organized under the laws of the state of Illinois, has constructed an artificial channel from Robey street, Chicago, to Lockport, and has heretofore been granted permission by the Secretary of War to make certain improvements in the Chicago river for the purpose of correcting and regulating the cross section of the river so as to secure a flowage capacity of 300,000 cubic feet per minute with a velocity of $1\frac{1}{4}$ miles an hour, it being intended to connect the said artificial channel with the west fork of the South Branch of Chicago river at Robey street in the said city of Chicago ;

And whereas the said sanitary district of Chicago has now applied to the Secretary of War for permission to divert the waters of the said Chicago river and cause them to flow into the said artificial channel at Robey street, as aforesaid ;

And whereas the said sanitary district of Chicago represents that such movable dams and sluice gates as are necessary to at all times secure absolute and complete control of the volume and velocity of flow through the Chicago river have been constructed ;

Now, therefore, the Chief of Engineers having consented thereto, this is to certify that the Secretary of War hereby gives permission to the said sanitary district of Chicago to open the channel constructed and cause the waters of Chicago river to flow into the same, subject to the following conditions :

1. That it be distinctly understood that it is the intention of the Secretary of War to submit the questions connected with the work of the sanitary district of Chicago to Congress for consideration and final action, and that this permit shall be subject to such action as may be taken by Congress.

2. That if, at any time, it become apparent that the current created by such drainage works in the south and main branches of Chicago river be unreasonably obstructive to navigation or injurious to property, the Secretary of War reserves the right to close said discharge through said channel or to modify it to such extent as may be demanded by navigation and property interests along said Chicago river and its south branch.

3. That the sanitary district of Chicago must assume all responsibility for dam-

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ages to property and navigation interests by reason of the introduction of a current in Chicago river.

Witness my hand this 8th day of May, 1899.

[SEAL.]

JOHN M. WILSON,

Brigadier-General, Chief of Engineers, U.S. Army.

R. A. ALGER,

Secretary of War.

[Permit of April 9, 1901.]

Whereas, under date of May 8, 1899, the Secretary of War granted permission unto the sanitary district of Chicago to open the artificial channel from Robey street, Chicago, to Lockport, and cause the waters of Chicago river to flow into the same, upon the following conditions, *inter alia* :

'2. That if, at any time, it become apparent that the current created by such drainage works in the south and main branches of Chicago river be unreasonably obstructive to navigation or injurious to property, the Secretary of War reserves the right to close said discharge through said channel or to modify it to such extent as may be demanded by navigation and property interests along said Chicago river and its south branch ;'

And whereas it is alleged by various commercial and navigation interests that the present discharge from the river into the drainage canal sometimes exceeds 300,000 cubic feet per minute, causing a velocity of nearly 3 miles per hour, which greatly endangers navigation in the present condition of the river ;

Now, therefore, this is to certify that the Secretary of War, upon the recommendation of the Chief of Engineers, hereby directs said sanitary district to regulate the discharge from the river into the drainage canal so that the maximum flow through the Chicago river and its south branch shall not exceed 200,000 cubic feet per minute.

Witness my hand this 9th day of April, 1901.

[SEAL.]

ELIHU ROOT,

Secretary of War.

[Permit of July 23, 1901.]

THE SANITARY DISTRICT OF CHICAGO,
SECURITY BUILDING,

CHICAGO, July, 15, 1901.

SIR,—I have the honour to request, on behalf of the sanitary district of Chicago, that your order of April 9, 1901, restricting the flow of water through the Chicago river to 200,000 cubic feet of water per minute, may be so amended as to permit the controlling works at Lockport, the outlet of the main drainage channel, to be so regulated as to permit at that point a flow of 300,000 cubic feet of water per minute between the hours of 4 p.m. and 12 o'clock midnight.

The board of trustees of the sanitary district have rigidly observed the restrictions of your order of April 9, 1901, but the result has been that the water in the main drainage channel has become greatly polluted and very offensive both to sight and smell, and is working such hardship upon the valley communities as to evoke frequent protests from various cities and municipalities along the Des Plaines and Illinois valleys.

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By such a modification of your restricting order as is herein petitioned, it would be possible for the sanitary district to secure much better drainage of the city of Chicago and the purification of the waters of the Chicago river without any hardship or inconvenience whatever to the interests of navigation, as the opening of the controlling works to a flow of 300,000 cubic feet of water per minute would produce no appreciable effect upon the current of the Chicago river until three hours thereafter and would not produce the full effect until about eight hours after the opening of the gates. Therefore, by again diminishing the flow at midnight to the requirements of your order, or to 200,000 cubic feet of water per minute, the normal condition in the Chicago river would be restored before 6 a.m. on the following day and thus no hardship or inconvenience occasioned to the navigation interests of the Chicago river.

I have the honour to be, very respectfully, yours,

ALEX. J. JONES,

President.

To the Hon. ELIHU ROOT,

Secretary of War, Washington, D.C.

[Second indorsement.]

OFFICE, CHIEF OF ENGINEERS, U.S. ARMY,

July 22, 1901.

Respectfully returned to the Secretary of War.

By an instrument, dated April 9, 1901, the Secretary of War directed the sanitary district of Chicago to regulate the discharge from the Chicago river into the drainage canal so that the maximum flow through the Chicago river and its south branch shall not exceed 200,000 feet per minute.

The sanitary district now asks that this order be so amended as to permit an increase of the flow into the canal to 300,000 cubic feet per minute between 4 p.m. and 12 midnight, daily.

It is the opinion of Major Willard, expressed in the accompanying letter of the 16th instant, that the request should be granted subject to revocation by the Secretary of War in case the increase be found dangerous to navigation.

I concur in this opinion and recommend that the order of April 9, 1901, be modified accordingly.

G. L. GILLESPIE,

Brigadier-General, Chief of Engineers, U.S. Army.

[Third indorsement.]

WAR DEPARTMENT,

July 23, 1901.

Approved as recommended by the Chief of Engineers.

E. ROOT,

Secretary of War.

[Permit of December 5, 1901.]

Whereas, under date of May 8, 1899, the Secretary of War granted permission unto the sanitary district of Chicago to open the artificial channel from Robey street, Chicago, to Lockport, and cause the waters of Chicago river to flow into the same, upon the following condition, *inter alia* :

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'2. That if at any time it becomes apparent that the current created by such drainage work in the south and main branches of Chicago river be unreasonably obstructive to navigation or injurious to property, the Secretary of War reserves the right to close said discharge through said channel or to modify it to such extent as may be demanded by navigation and property interests along said Chicago river and its south branch.'

And whereas the Secretary of War subsequently directed said sanitary district of Chicago to regulate the discharge of water into the Chicago Drainage canal so that the maximum flow through the Chicago river shall not exceed 200,000 cubic feet per minute from midnight to 4 p.m., nor 300,000 cubic feet per minute from 4 p.m. to midnight.

And whereas said sanitary district of Chicago has applied to the Secretary of War for permission to increase the flow between midnight and 4 p.m. daily to 250,000 cubic feet per minute, and the Chief of Engineers has recommended that the increase applied for be granted, but that the rate of flow from 4 p.m. to midnight be reduced to 250,000 cubic feet per minute, so that the flow through the Chicago river shall not exceed 250,000 cubic feet per minute throughout the twenty-four hours of the day ;

Now, therefore, this is to certify that, in accordance with the recommendation of the Chief of Engineers, the Secretary of War hereby gives unto said sanitary district of Chicago permission to regulate said discharge so that the maximum flow through the Chicago river shall not exceed 250,000 cubic feet per minute throughout the twenty-four hours of the day, upon the following conditions :—

1. That this permission shall be in lieu of the present authorized rates of flow as stated above.

2. That the permission herein given shall be subject to such modification as in the opinion of the Secretary of War the public interests may from time to time require.

3. That said sanitary district of Chicago shall be responsible for all damages inflicted upon navigation interests by reason of the increase in flow herein authorized.

Witness my hand this 5th day of December, 1901.

WM. CARY SANGER,

Assistant Secretary of War.

[Permit of January 17, 1903.]

Whereas, under date of December 5, 1901, by an instrument supplementary to the original permission granted by the Secretary of War, May 8, 1899, to the sanitary district of Chicago to open the artificial channel from Robey street, Chicago, to Lockport and cause the waters of Chicago river to flow into the same, the Secretary of War, pursuant to authority reserved in said permission of May 8, 1899, gave permission to the sanitary district of Chicago to regulate said discharge so that the maximum flow through the Chicago river shall not exceed 250,000 cubic feet per minute throughout the twenty-four hours of the day, upon the following condition, *inter alia* :

'That the permission herein given shall be subject to such modification as in the opinion of the Secretary of War the public interests may from time to time require.'

And whereas the said sanitary district of Chicago has applied for permission to increase the flow through the Chicago river from 250,000 cubic feet per minute to 350,000 cubic feet per minute during the closed season of navigation, in order to carry off the accumulations of sewage deposit which line the shores along said city :

Now, therefore, this is to certify that, in accordance with the recommendation of the Chief of Engineers, the Secretary of War hereby gives unto said sanitary district of Chicago permission to increase the flow through the Chicago river from 250,000 cubic feet per minute to 350,000 cubic feet per minute until the 31st day of March, 1903,

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after which date it shall be reduced to 250,000 cubic feet per minute, as now authorized, upon the following conditions :—

1. That the permission herein given shall be subject to such modifications as in the opinion of the Secretary of War the public interests may from time to time require.

2. That said sanitary district of Chicago shall be responsible for all damages inflicted upon navigation interests by reason of the increase in flow herein authorized.

Witness my hand this 17th day of January, 1903.

[SEAL.]

WM. CARY SANGER,
Assistant Secretary of War.

APPENDIX E.

Resolved by the Senate, the House of Representatives concurring herein:

1. That it is the policy of the state of Illinois to procure the construction of a waterway of the greatest practicable depth and usefulness for navigation from Lake Michigan via Des Plaines and Illinois river to the Mississippi river, and to encourage the construction of feeders thereto of like proportions and usefulness.

2. That the United States is hereby requested to stop work upon the locks and dams at Lagrange and at Kampsville, and to apply all funds available and future appropriations to the improvement of the channel from Lasalle to the mouth, with a view to such a depth as will be of present utility, and in such manner as to develop progressively all the depth practicable by the aid of a large water supply from Lake Michigan at Chicago.

3. That the United States is requested to aid in the construction of a channel not less than 160 feet wide and 22 feet deep, with such a grade as to give a velocity of 3 miles per hour from Lake Michigan, at Chicago, to Lake Joliet, a pool of the Des Plaines river immediately below Joliet, and to project a channel of similar capacity and not less than 14 feet deep from Lake Joliet to Lasalle, all to be designed in such manner as to permit future development to a greater capacity.

Adopted by the Senate, May 27, 1889.

Concurred in by the House of Representatives, May 27, 1889.

APPENDIX F.

REPORT to the International Waterways Commission on the disposal of Sewage of Chicago and Vicinity, by Rudolph Hering and George W. Fuller, December 18, 1906.

NEW YORK CITY, December 18, 1906.

To the International Waterways Commission :

SIRS,—In response to your recent request we beg to report herewith upon several propositions connected with the question of extending the method of disposing of the sewage of Chicago and vicinity by means of dilution with Lake Michigan water. Your instructions may be briefly summarized as follows :—

1. Examination into the sanitary situation at Chicago so far as it is affected by sewage disposal.

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2. Latest conclusions of sanitary engineers as to the amount of dilution which is required to make sewage inoffensive.

3. Is the extension of the dilution method to the outlying territory the only way to preserve the lives and health of the people of Chicago?

4. For the Calumet area, are there not other methods of sewage disposal which may be applied at a cost not exceeding much, if at all, the cost of the method of dilution proposed, and which will be equally effective in preventing the pollution of the lake waters?

5. Description of the various systems of sewage disposal which are available for the Calumet area, with a statement of their relative efficiencies.

6. Statement of the approximate relative costs of the last mentioned so far as they can be given without the preparation of detailed plans.

You further state clearly in your letter of instructions that you do not desire an investigation into the effect of the present method upon the navigation interests of the Great Lakes, as that has already been officially considered by yourselves. Further, you state that you accept as a fixed fact the Chicago Drainage canal as designed and built, with its attendant diversion of 10,000 cubic feet per second of lake water through the Chicago river and its branches.

In accordance with further instructions we have not given consideration to questions of a legal or legislative nature. We have viewed this problem solely as an engineer proposition without regard to inter-state questions and other features associated with the fact that a portion of the future metropolitan area of Chicago will obviously lie within the state of Indiana. It is further understood that under the existing circumstances we are to give you our opinion without entering into such details as would be required by additional surveys or other field work beyond a personal inspection of the areas.

SEWAGE DISPOSAL AT CHICAGO.

Drainage canal.—Nearly all of the sewage from the population of Chicago now connected with sewers is diluted with Lake Michigan water, which, since January 17, 1900, has been allowed to flow through the new drainage canal and thus reach the valley of the Illinois river. This method of disposal is the outcome of various investigations, particularly of a commission on the drainage and water supply of Chicago in 1886-87. It was formally adopted in 1889 by state legislation, creating the 'Sanitary District of Chicago,' specifically providing that the volume of lake water for purposes of dilution shall be $3\frac{1}{2}$ cubic feet per second for each 1,000 of population connected with the sewers, or 20,000 cubic feet per minute for each 100,000 population.

Early methods.—In early days part of the sewage of Chicago flowed directly into the lake and part into the Chicago river and its branches. From the latter a portion of the water and sewage, beginning over thirty-five years ago, has been pumped at Bridgeport into the Illinois and Michigan canal, as is true to some extent to-day. It is understood that the old canal is to be discontinued by legislative action as soon as equivalent transportation and power facilities can be arranged for by means of the new canal.

Area of sanitary district.—In 1903, an Act of legislature was passed extending the area of the sanitary district from 185 to 358.1 square miles, and including the 'north shore addition' of 78.6 square miles, and the 'Calumet addition' of 94.5 square miles. The area of the City of Chicago is 190,638 square miles, leaving 167,462 square miles as the area of the present sanitary district outside of the city limits.

There are several features to be noted in connection with the method of sewage disposal of the city of Chicago as adopted in 1889. It had been found to be the cheapest method then available for disposing of the sewage so that it would not pollute the public water supply, which was then and is now derived from Lake Michigan through a series of intake cribs located at various distances from shore.

Intercepting sewers.—To prevent such pollution it was of course necessary first to divert all of the sewage into the Chicago river. A pure-water commission was appointed by the mayor in 1897 to consider the question of intercepting sewers for that purpose. It recommended among others a large intercepting sewer to collect the sewage from the area along the lake front between Seventy-third and Thirty-first streets, and about a year ago a 20-foot conduit was completed on Thirty-ninth street, through which the diluted sewage from this area now passes to the south fork of the south branch of the Chicago river. At present there is a gravity flow of lake water ordinarily of about 40,000 cubic feet per minute. Pumps are now in process of erection by which ultimately there will be pumped through this conduit about 120,000 cubic feet of lake water per minute, or 2,000 cubic feet per second.

On Twenty-second street there was formerly a main sewer draining the area bordering on the lake front between Thirty-first and Sixteenth streets, and discharging into the lake. In 1898 the flow in this sewer was reversed so that its contents now discharge into the river.

On Twelfth street, in 1898, the flow in the main sewer was also reversed. In the heart of the city, or business section, the sewers have always discharged into the river and not into the lake. The same is true of a considerable area lying north of the Chicago river and along the lake shore. To facilitate this discharge a conduit was put in service in 1880 at Fullerton avenue, through which there has been pumped about 12,000 cubic feet of lake water per minute into the north branch of the Chicago river.

At the present time there is no sewage entering the lake between Surf street (just north of Lincoln Park) on the north side and Seventy-third street on the south side of Chicago.

Plans are under way for the construction of the necessary works to collect the sewage along the lake front between Seventy-third and Eighty-seventh streets and to pump it into sewers west of Halsted street, which lead to the Chicago river. There is very little or no sewage from this area now reaching the lake, as the district is yet practically unsewered.

On the north side there is an area between Surf street and the northern city limits and between the lake shore and the ridge between the lake and the river, which now discharges sewage into the lake, but which will be diverted next summer. This sewage is to be collected by interceptors conducting it to Lawrence avenue, where will be located a pumping station and a conduit for pumping the sewage and about 35,000 cubic feet of lake water per minute into the north branch of the Chicago river.

Farther north, at Wilmette, a conduit is proposed to be built with a pumping station near the Northern Railroad bridge in Evanston, where about 60,000 cubic feet of lake water per minute will be diverted into the north branch of the Chicago river.

Summary of flow to canal.—The projected flow of the lake water to the canal through the Chicago river and its branches to the drainage canal may therefore be divided and summarized as follows :—

	Cubic feet, per minute.	Cubic feet, per second.
Main stream, Chicago River	373,000	6,217
Thirty-ninth street conduit	120,000	2,000
Fullerton avenue conduit	12,000	200
Lawrence avenue conduit	35,000	583
Wilmette conduit	60,000	1,000
Total	600,000	10,000

The volume for the main stream of the Chicago river as above stated is obtained by deducting the remaining quantities from the total.

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REQUIREMENTS FOR THE REVERSAL OF FLOW IN THE CHICAGO RIVER.

The satisfactory disposal of the sewage of Chicago by means of the new drainage canal requires that, at and after heavy rainfalls, the storm water and sewage from the watershed of the Chicago river shall not flow into Lake Michigan, and therefore it is necessary to secure a practical reversal of the original flow in the Chicago river.

The drainage area of the Chicago river is about 270 square miles. Flood flows in the river have reached a maximum of about 10,000 cubic feet per second, or 600,000 cubic feet per minute, and this fact was also an important element in fixing the minimum size of the present drainage canal.

As to the efficiency of arrangements for the reversal of flow, our inquiries lead us to believe that this has been accomplished in a satisfactory way. Up to the present time, and owing to the insufficient waterway of some parts of the Chicago river, the volume of Lake Michigan water going through the river has not approached the volume above stated. But there have been times when a continuous flow of the Chicago river has been towards Lake Michigan for perhaps two or three hours. This time is necessary to properly regulate the water level at the controlling works near Lockport.

POPULATION OF CHICAGO NOW SEWERING INTO THE DRAINAGE CANAL.

We find that the present population of Chicago is, in round numbers, 2,000,000 people, of which between 100,000 and 200,000 reside south of Eighty-seventh street, tributary to the Calumet district, but within the city limits. Of the remaining population about 300,000 reside in the southern lake front district. This area is tributary to the Thirty-ninth street pumping station, which, since about January 1, 1906, has brought about the diversion of the sewage from the lake into the south fork of the south branch of the Chicago river.

There is still an area in the northwestern part of the city north of Lincoln Park, spoken of as the Northern Lake Front district, which drains directly into the lake. Its population may be very roughly estimated at 70,000.

There is a considerable area south of Seventy-third street and west of Halsted street, and also a portion of the northwestern part of the city which are of a semi-suburban character. Some portions have been provided with sewers and receive the overflow from cesspools.

So far as we are able to ascertain from local officials and without making a personal canvass as to details, it appears that there are now, in round numbers, about 1,500,000 people sewerage into the drainage canal. In addition to the sewage there enters it a considerable quantity of trade wastes, notably about 2,000,000 gallons from the stock-yard district, and from quite a number of other industrial establishments, such as tanneries, wool-pulling establishments, &c., as stated by the sanitary inspector in the last report of the health department.

It is our understanding that the present sewage disposal project for Chicago is not intended to provide for the disposal of trade wastes now discharged into the sewers. While comparatively little has been done as yet to remove them from the sewers, we have been informed that it is proposed to take up this matter actively.

INFLUENCE OF SEWAGE ON CHICAGO WATER SUPPLY.

The city of Chicago receives its water supply from Lake Michigan through a series of tunnels of various lengths, ranging from about 1 to 5 miles from shore. Most of them extend from the shore about 2 miles. The total pumping capacity for this supply is stated to be 529,000,000 gallons in twenty-four hours. In 1905 the average daily pumpage was recorded as 399,000,000 gallons.

Since the removal of the sewage through the drainage canal was systematically begun in January, 1900, the appearance of the water of the Chicago river has shown marked improvement.

The effect of the drainage canal upon the hygienic quality of the public water supply may be studied in connection with the typhoid fever death rates at Chicago, which are recorded in the next table, together with corresponding death rates for a number of other American cities. It is not to be assumed that typhoid fever is entirely due to the pollution of the public water supply at Chicago or elsewhere, as it is well known that there are other means of transmitting this disease. But its relation to the public water supply is so intimate that it gives, perhaps, the best general idea of the sanitary quality of the water, and therefore it frequently has been used as a rough means of such measurement.

There are other factors beside the drainage canal to be considered carefully in connection with the typhoid fever statistics at Chicago, and some of which should be mentioned here. Prior to 1900 there was a substantial improvement in the public water supply, partly due to the extension of some of the intake cribs and tunnels farther into the lake and partly to the reversal of the flow of a number of the sewers from the lake into the river, such as those at Twelfth and Twenty-second streets, in 1898. These are important factors in explaining the absence in the late nineties of such excessive typhoid death rates as were noted at the beginning of that decade.

Since the opening of the drainage canal typhoid fever at Chicago has been rather unusually prevalent at times. This was especially true in 1902-3, when, it is understood, portions of the supply became contaminated after leaving the intake crib. These accidental pollutions have since been corrected.

The report of the city chemist of Chicago, as given in the last annual report of the department of health, shows that on an average in 1905, the city water supply was considered by him to be safe about 85 per cent of the time.

While there has been a marked improvement in recent years in the quality of the Chicago water supply, due to the progressive elimination of sewage from the lake, there is still room for more improvement. These improvements refer to the pollution along the lake front north of Lincoln Park, which is being corrected, and to the 'Calumet area' south of Eighty-seventh street, which is now under consideration.

COMPARISONS of the Annual Number of Recorded Deaths from Typhoid Fever per 100,000 population at Chicago and other American Cities, 1890-1905.

Year.	Chi- cago.	Mil- wau kee.	De- troit.	Cleve- land.	Buf- falo.	To- ronto.	Bos- ton.	New York.	Philia del- phia.	Balti- more.	Wash- ington
1890.....	83	33	18	69	44	80	43	21	64	57	89
1891.....	160	33	13	50	56	90	33	22	64	34	86
1892.....	103	31	64	59	38	40	25	14	40	42	72
1893.....	42	37	29	52	37	40	26	20	40	47	72
1894.....	31	26	27	29	62	20	23	17	32	49	72
1895.....	32	25	24	35	28	30	32	17	40	28	69
1896.....	53	18	23	43	22	24	32	16	34	37	51
1897.....	29	11	15	23	19	18	33	16	33	37	42
1898.....	38	17	18	34	29	16	34	20	51	38	64
1899.....	26	17	13	32	26	19	30	16	75	30	82
1900.....	20	21	18	54	27	19	25	21	35	37	77
1901.....	29	21	20	36	27	16	25	20	33	27	67
1902.....	44	16	17	33	33	13	35	21	44	42	79
1903.....	31	17	17	114	35	15	20	18	70	36	48
1904.....	19	13	16	48	91	22	18	17	.....	36	43
1905.....	16	20	12	15	23	.....	20	16	48	36	45

LATEST CONCLUSIONS AS TO THE REQUIRED DEGREE OF DILUTION FOR THE DISPOSAL OF SEWAGE WITHOUT NUISANCE.

The disposal of sewage by dilution depends on the amount of oxygen in the diluting water being sufficient to prevent putrefaction of the organic matter in the sewage as the latter undergoes bacterial decomposition. If the oxygen is deficient, bacterial decomposition produces what is called 'putrefaction,' with its various attendant bad

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odors, such as noted for years in Chicago at 'Bubbly creek.' If there is a sufficient amount of oxygen dissolved in the water to combine with this organic matter, decomposition goes on without any foul odors and the organic matter is reduced to inert matter in an inoffensive way.

This question is one of balancing the amount of oxygen in a given volume of water with the amount of decomposing organic matter in the sewage, which naturally must vary greatly.

There are many observations of more or less accuracy available to give figures for this relation. The Massachusetts state board of health made a special inquiry into this subject for all local rivers in 1902, with conclusions, stated on page 452 of their annual report for that year, as follows :—

'The results of the investigations show that where the quantity of water available for the dilution of the sewage in a stream exceeds about 6 cubic feet per second per 1,000 persons discharging sewage, objectionable conditions are unlikely to result from the gross pollution of all the water of a stream in dry weather. Under favourable circumstances, such as in cases where the sewage is discharged at many outlets into a large body of water, objectionable conditions may not result where the dilution is somewhat less than 6 cubic feet per second per 1,000 persons ; but objectionable conditions have resulted in all of the cases thus far examined where the flow has been less than 3.5 cubic feet per second per 1,000 persons discharging sewage into the stream.'

These conclusions apply for the most part to comparatively small streams into which much manufacturing waste is discharged and upon which mill-ponds are situated.

There are times when the flow of water in the drainage canal appears to have been insufficient to eliminate objectionable odors entirely. How far this may be explained by confusion on the part of the observers of the putrefactive odors, emanating from the Illinois and Michigan canal with those of the new canal, and how far it may be due to temporary reductions in the rate of flow in the new canal and river to facilitate construction work, and also to the effect of rainfalls and to old deposits in the south fork, we are unable to say.

The new canal appears to serve at present about one-half the population for which it was designed, and through it flows a volume of lake water which is variable, but which averages not far from one-half of the ultimate quantity.

It is our judgment that for large canals with the trade wastes eliminated a dilution of $3\frac{1}{2}$ cubic feet per second for each 1,000 population connected with the sewers also receiving storm water is as low a figure as it is now possible to state. Local conditions, especially temperature, which affects bacterial activities and the coefficient of absorption of oxygen by water, and still other matters, bear upon this question, the detailed discussion of which is not now necessary. We feel certain that a dilution of $2\frac{1}{2}$ cubic feet per second would cause offence at times, and probably also a dilution of 3 cubic feet per second.

FUTURE POPULATION ON AN AREA TRIBUTARY TO THE CHICAGO RIVER AND DRAINAGE CANAL
WITH REFERENCE TO SEWAGE DISPOSAL.

On the basis of the diversion of 10,000 cubic feet per second of Lake Michigan water, on the present assumption of $3\frac{1}{2}$ feet per second as being the volume to be provided for each 1,000 population connected with the sewers, and on the assumption of eliminating objectionable trade wastes, the present method of disposal may serve until the population on the drainage area of the Chicago river reaches 3,000,000 people.

On the further assumption that through the Chicago river and various conduits connected with its branches there will be a flow equal to 14,000 cubic feet per second, which is the capacity of the rock section of the drainage canal, the maximum population which might be taken care of in this way is about 4,200,000 people.

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With a large portion of the 270 square miles draining into the Chicago river, but not yet built up, even on a suburban basis, it is evident that in future years there will be a much greater population than now exists.

We have considered the rate of growth of Chicago from various viewpoints, notably the density of its population, and have compared its growth with that of other metropolitan districts. There is, of course, no way of predicting accurately how rapid will be the growth of Chicago in future years; but it is a reasonable assumption that before many years it will become a city of some five or six millions of population. It seems reasonable to infer that the population residing upon the area tributary to the Chicago river and its branches will ultimately exceed both the 3,000,000 and 4,200,000 estimates above mentioned. In other words, the present dilution method will certainly not alone for all time take care of the crude sewage of this area.

There are several available methods for the purification of sewage, depending upon the degree of purification desired, as will be noted beyond in connection with the Calumet area.

It is not probable that the sewage of the old part of Chicago will ever be purified by artificial means, as it would be proportionately much more difficult and expensive to deliver the sewage to suitable sites for purification than to continue the present dilution method. It is different with the outlying districts tributary to the Chicago river. In the future, when these districts become built up so that the population exceeds the limits above stated, the installation of sewage purification works will necessarily follow.

PROPOSED CALUMET CANAL.

The more essential features of this proposed canal, as obtained from local officials, may be summarized as follows :—

Location.—The canal would extend from a point on the Little Calumet river, near Blue island, through the Sag valley, and enter the drainage canal near Sag station.

Territory tributary.—The total drainage area of the Calumet river is 825 square miles, of which 473 are in Indiana. Within the limits of the sanitary district of Chicago and south of Eighty-seventh street, the area is 94.5 square miles, with a population of about 100,000 in 1900. It is stated that the population has nearly doubled within the past six years, and it is expected to reach a million people or more within a fairly short period, as the conditions for a manufacturing district are very favourable.

Size.—The size of this canal, as proposed, is such as to give a flow of 4,000 cubic feet per second.

Reversal of flow.—The natural flow of the Calumet river exceeds 12,500 cubic feet per second. It is proposed, if suitable legislation can be secured, to construct a dam below Thorn creek, at the southern boundary of the sanitary district, and divert into Lake Michigan, through a channel to be built about 17½ miles east of the state line, the flow of this stream, with a drainage area of about 587 square miles. The size of the proposed Calumet canal is too small to secure at all times a reversal of flow of the remaining portion of the area, which is about 240 square miles. It is proposed to put a controlling lock on the canal east of Blue island to prevent flood waters from this lower area entering the canal, at which times sewage entering the river on the lake side of the lock would go into the lake.

The proposed canal is insufficient to carry, in the future, all the storm flows of the Sag valley itself. These would, at least, in part, require diversion through present or other channels.

Cost.—The estimated cost of this proposed canal is \$12,000,000.

Population to be served.—On the assumption already stated, this canal, by dilution, would dispose of the sewage of about 1,200,000 people, not including objectionable trade wastes. This makes the cost of sewage disposal \$10 per capita for the entire

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future population, or about \$60 for the present population. The sewage would for the most part reach the canal by gravity through the Calumet river, so that the cost of maintenance would be comparatively small.

In passing, we may say that the Calumet area, both in Illinois and Indiana, is certain to develop rapidly, and its population will eventually far exceed the above figure.

RELATION OF SEWAGE DISPOSAL FOR THE CALUMET AREA TO THE WATER SUPPLY OF CHICAGO.

For the reasons above stated in connection with the reversal of flow, the sanitary effect upon Lake Michigan water at the Hyde park intake and vicinity of this proposed Calumet canal would not be nearly as effective as that of the main canal for the Chicago river territory and neighbouring intakes. This fact is important in connection with the degree of sewage purification required by artificial purification works to give a sanitary effect equal to that of the proposed canal.

There seems to be no doubt that at times the sewage entering the Calumet river under present conditions from this district pollutes the lake water from the Hyde park intake crib. It may pollute the water at other intakes, but our evidence is not conclusive. In the future, when the Calumet area is built up, it is possible that intake cribs may be built nearer to the mouth of the Calumet river than is the Hyde park intake.

In view of the fact that the proposed Calumet canal can not keep all sewage out of Lake Michigan at times of heavy rainfall, it is important to note that the water supply of this section of Chicago will eventually have to be purified by modern filtration works. This can be done at moderate cost, and it will be the cheapest and best solution of this problem to filter the water supply of this district and to purify the sewage to such a degree that the effluent will be fairly clear and non-putrescible, that is, free from disagreeable odours. With additional expense the sewage effluent (of the quality just stated) can be given a supplementary purification, making it practically free of bacteria by treating it with a germicide or by filtering it according to water purification practice.

Under existing conditions we are firmly of the opinion that all the purification required of the sewage of the Calumet district is to make it fairly clear and non-putrescible.

AVAILABLE METHODS OF SEWAGE DISPOSAL OTHER THAN THAT OF THE DILUTION METHOD
PROPOSED FOR THE CALUMET AREA.

The degree of purification of sewage by various forms of treatment differs naturally under different local conditions, but from general experience approximate results may be compared, substantially as follows :—

Method.	Percentage purification.		
	Suspended matter.	Organic matter.	Bacteria.
Fine screens (30-mesh or finer)	15	10	15
Sedimentation	65	30	65
Septic treatment	65	30	65
Chemical precipitation	85	50	85
Contact filters <i>a</i>	85-90	65-70	80-85
Sprinkling filters <i>a</i>	85-90	65-70	90-95
Intermittent sand filters <i>a</i>	95-99	90-98	98-99

*a*The figures for the last three forms of treatment are on the assumption that the sewage is given some form of preparatory treatment before it is applied to the filters, and that with the sprinkling filters the effluent is allowed to settle.

It is to be stated that none of the first four treatments above tabulated will by itself give a non-putrescible effluent. Therefore they can be used here only in connection with some form of filtration.

For large works, filters can be more economically operated if the sewage is first clarified in part, as stated in connection with the above summary. The most appropriate method for this preparatory or preliminary treatment is considered by most sanitary engineers in this country and abroad to consist of septic tanks, which is the expression applied to sedimentation basins in which the deposited sludge is allowed to accumulate to undergo bacterial action.

There are several forms of filters, the most widely known of which, in this country, is the intermittent sand filter, sometimes mentioned as the so-called 'land treatment' for sewage disposal. This method was considered in 1886-87 for the entire Chicago area and reported upon unfavourably on account of its being more expensive than the adopted method of dilution.

Local experience.—We find that a feeling appears to prevail among some persons at Chicago against land treatment of sewage, due perhaps to the unsuccessful operation of the sewage farm at Pullman, which is situated within this Calumet area.

We are familiar with the facts and experiences at Pullman, and are clearly of the opinion that they are not necessarily a criterion for the Calumet area. This opinion is based partly upon the small size of particles of the soil at the Pullman farm, and partly upon the fact that the farm was devoted principally to agricultural rather than sewage purification purposes.

Sand areas.—We have examined the tracts of lake sand which are found in Indiana and to a limited extent in the township of Thornton, Ill. The latter areas are too limited in extent and too shallow to be considered for present purposes. The only areas of suitable porous sand for land treatment of the Calumet sewage are in Indiana.

We have collected five samples of this sand for mechanical analysis, and have obtained the results as to size of sand grains. Representative results average substantially as follows :—

	Millimeters.
Effective size....	0.15
Uniformity coefficient..	1.40

If we disregard the state boundary line, a large tract of sand of a suitable character is available for the disposal of the sewage of this district. The best area lies between the Little Calumet and the Grand Calumet rivers, and extends east of Hammond for many miles.

Within the past six or eight years great strides have been taken in the field of sewage purification in connection with works of wholly artificial construction. We refer particularly to filters of coarse, firm material, such as broken stone, slag or clinker, and usually spoken of as 'coarse-grained filters,' as distinguished from fine-grained sand filters.

Coarse-grained filters are of two types, spoken of as 'contact filters' and 'sprinkling filters,' according to the method by which the sewage is applied to them. These filters produce an effluent which will not putrify when they are operated at a rate far greater than that which is possible for sand filters.

We shall describe briefly each of these types of sewage-purification methods and state their approximate cost of construction on suitable sites for the Calumet area, based upon unit prices in accordance with experience elsewhere.

An outline is first required, however, of the intercepting sewers, pumping stations, and rising mains necessary to collect and deliver the sewage to the filter sites, of which there are several available.

Regardless of the particular kind of filter found most suitable for the Calumet area, there are a number of features common to all methods, and which may be stated as follows :—

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Separate sewers.—With the adoption of sewage filters for this district we are clearly of the opinion that it would be advisable hereafter to build a separate system of sewers for domestic sewage only. Some, if not all, of the existing main sewers could be used for the removal of storm and surface water only, and new sewers parallel them for sewage removal; or, some of the existing sewers could be utilized for sewage removal, requiring new structures for storm-water removal. Trade wastes should be excluded from all sewers. We have obviously not included in the cost of purifying the sewage any expense for the main sewers or laterals to collect it and deliver it to the interceptors.

Volume of sewage.—We have assumed that the sewage of this district will approximate 130 gallons per capita daily on an average. With a population of 1,200,000 the total volume of sewage would therefore be about 156,000,000 gallons daily. We have also allowed for ground-water seepage up to 1,000 gallons per square mile per day.

Interceptors.—For purposes of making approximate but liberal estimates of cost of purifying the sewage of this district, we have prepared sketches showing the intercepting sewers which will be required in order to collect the sewage of the district at four or more centrally located pumping stations. We have assumed that these intercepting sewers will be built of concrete, and when flowing full, have a capacity of 250 gallons per twenty-four hours for each person resident upon the area tributary to the interceptor. When full, these interceptors have been assumed to have a velocity of 2.5 feet per second. We have also assumed, after excluding that portion of the Calumet district reached by extreme high water in the lake, that on an average the population contributing to the four or more pumping stations would be about 20 to 25 persons per acre. On this basis the length and size of the necessary intercepting sewers have been obtained.

Pumping stations.—For convenience we have located four main pumping stations near Riverdale, Harvey, South Hammond, and South Chicago. There will be required, when the district is built up to the extent herein considered, a total pumping capacity of about 340,000,000 gallons daily, including necessary reserve capacity at each station.

Septic tanks.—Regardless of the type of filter adopted, the sewage would be screened at the pumping stations, and then flow through septic tanks having a capacity of eight hours' flow on an average. These tanks would be about 12 to 15 feet deep, built of concrete, and arranged in compartments, so as to facilitate septic action on the deposited sludge, but without such action taking place in the flowing sewage itself. Owing to the severe winter climate in this vicinity, it is our opinion that it would be wise to cover these tanks.

Of the solid matters in suspension in the sewage about 65 per cent would deposit in the septic tanks, and of these deposited solid matters about one-half would be liquified and gasified by bacterial decomposition.

The sludge, which would be removed at intervals of once a year or so from the tanks, is estimated to contain about 85 per cent water and to amount to about 2 cubic yards per 1,000,000 gallons. Bacterial action converts this sludge to a practically inert mass which can be pumped in thin layers on to adjoining land and allowed to dry.

This is the form of preliminary treatment in use in some 40 places in this country, including Plainfield, N.J., Saratoga, N.Y., Mansfield, Ohio, Champaign, Ill., &c. It is the preliminary step in the works under construction at Columbus, Ohio, after elaborate tests of different methods were made for a period of nearly one year. It has also been adopted recently at Baltimore, Md., Reading, Pa., and Waterbury, Conn., and has been recently proposed for Paterson, N.J., in a somewhat modified form.

This form of preliminary treatment has been and is now extensively used in Europe with satisfactory results where the tanks are built and operated to meet local conditions as to volume and strength of sewage.

The odors from large open septic tanks are seldom noticeable a few hundred feet away. Under good management, a septic effluent can be applied to sprinkling filters, so that no objectionable odors should be carried one-quarter of a mile.

The cost of building and operating septic tanks would be substantially the same for all filler projects, and is considered under each as a common factor.

INTERMITTENT SAND FILTERS.

This well-known method consists of applying the partially clarified sewage coming from the septic tanks to areas of porous sand, below the surface of which at depths of from 3 to 5 feet are underdrains of open-jointed pipe to convey the purified sewage to the nearest water course. The sewage is applied only at intervals of once a day or so to a depth of perhaps 6 inches. Between applications the sand layer is allowed to drain so that its pores may fill with air. This æration of the pores of the sand allows bacterial processes to convert the organic matter to a large extent to harmless mineral matter. The effluent is practically free of noticeable suspended matter and objectionable organisms and can be discharged directly into the nearest water course.

This method is now in successful use in 40 to 50 places in this country where porous sand areas are available. It serves a total population of about 350,000 people. Well-known plants are to be found at Framingham, Brocton, Clinton, and Worcester, Mass.; Pawtucket and Woonsocket, R.I.; Meriden and New Britain, Conn.; Saratoga, N.Y., &c.

From time to time it is necessary to rake, harrow, or plough the surface of intermittent sand filters and to remove the scum which slowly accumulates there. At intervals it is necessary to scrape off several inches of the upper portion of the sand layer when it is found that they are so clogged that harrowing and ploughing no longer prevents the surface from remaining covered with sewage.

With crude sewage it appears from Massachusetts evidence, especially from the tests conducted for a period of nineteen years at the Lawrence Experiment Station, that it would be necessary to provide 1 acre of intermittent sand filters for each 500 persons connected with the sewers when the sewage is given a preliminary treatment in septic tanks and when the filters are operated under intelligent supervision the area may be reduced so as to provide 1 acre per 1,000 persons.

The most suitable natural site for sand filters for the Calumet area is to be found in the State of Indiana, between the Little Calumet and the Grand Calumet rivers, east of the city of Hammond.

It is possible to build artificial sand filters within the Calumet district, but the cost would be much greater than for any of the projects considered in this report.

Based upon our knowledge of these filters elsewhere, and without considering inter-state complications, we estimate that the cost of installing and operating such a plant, with its various appurtenances, east of Hammond, and of a capacity of about 180,000,000 gallons daily to serve a population of 1,200,000 people, would be as follows:

Estimated cost of constructing sand filter plant and appurtenances.

Intercepting sewers, pumping stations, and appurtenances, including a daily capacity of 340,000,000 gallons, and rising mains.....	\$5,070,000
Septic tanks, 60,000,000 gallons capacity, covered, includ- ing sludge-disposal facilities.....	950,000
Intermittent sand filters, 1,200 acres, with distributors, drains, office, laboratory, &c..	3,600,000
	<hr/>
	9,620,000
Contingencies and supervision, 15 per cent...	1,443,000
	<hr/>
Total...	11,063,000

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Annual Cost of Operation.

Pumping, fuel, labour and repairs.....	\$300,000
Supervision, analytical and clerical assistants, &c..	25,000
Care of septic tanks, including sludge disposal..	36,000
Care of sand filters.....	480,000
Supplies and miscellaneous.....	25,000
	<hr/>
	866,000

Capitalizing the operating expenses at 5 per cent per annum there is obtained \$17,320,000, which, when added to the estimated construction cost, makes a total sum of \$28,383,000 for the sand-filter project.

CONTACT FILTERS.

These filters consist of beds of broken stone, slag, or cinders, placed in uncovered basins to a depth of from 3 to 5 feet. The size of material ranges from about one-fourth to 1 inch.

The filters are ordinarily operated upon the fill and draw plan, that is, the gate on the outlet pipe is closed until the voids of the bed are filled with sewage from the septic tanks. After filling, the filters are allowed to stand full for an hour or so, then the sewage is allowed slowly to drain out, and this cycle of operation is repeated once or twice a day.

When the filtering material is drained the voids fill with air, and it is during these periods of draining that bacterial processes accomplish the purification of the organic matter, which to a large degree is lodged upon the surfaces of the filtering material as the sewage is slowly withdrawn from the bed. The rates of filling and drawing the beds may be satisfactorily controlled by a number of automatic devices on the market and which are in successful use in a number of places.

Contact filters are an English adaptation of studies made some fifteen years ago upon the gravel filters by the Massachusetts State board of health at the Lawrence Experiment Station. These studies were begun about thirteen years ago at London. As an outcome of these and numerous other investigations, contact filters have been adopted and are in successful use for dozens of English cities, the largest of which is Manchester, with a population of about 600,000.

In this country, contact filters have been installed for a dozen or more small cities and numerous institutions. Perhaps the best known plants are at Plainfield, N.J., Mansfield, Ohio, and Charlotte, N.C. They are especially applicable to projects where only a small amount of head is available and where pumping would be required for sprinkling filters.

For large projects, and where pumping is not a factor, recent experiences with sprinkling filters show that as a rule they are more economical. Notwithstanding this, contact filters have served and will serve a useful purpose, in the field of sewage disposal in this country. Their conveniences of operation makes them especially suitable for small installations.

Many contact-filter plants have their beds arranged in terraces so that the sewage may be passed successively through two or three filters. There are a number of advantages of this arrangement, but it is not applicable to the Calumet district, owing to the level area of the available sites. One of the advantages of the double and triple contact filters is that they may be operated from below during winter weather and thus guard against reductions in the rate of filtration due to freezing.

The most available and suitable local sites are : A tract west of Harvey and between the Illinois Central and Rock Island railroads ; a tract west of Hammond and the local branch of the Fort Wayne railroad ; and a tract between Lakes Calumet and Wolf.

As to the rate of filtration, we have assumed that contact filters should be 5 feet in depth and that they would satisfactorily purify the effluent from septic tanks at the rate of 600,000 gallons per acre per twenty-four hours. This means that 1 acre of contact filters should be provided for every 4,000 persons connected with the sewers.

The effluent from contact filters operated under these conditions would be ordinarily free from objectionable amounts of suspended matter, and the amount of organic matter would be so reduced that it would not putrify upon standing. On an average about 15 to 20 per cent of the bacteria in the crude sewage would be present in the effluent. It would not be improper to discharge such an effluent as it came from the filters, directly into the nearest water course.

The amount of attendance required for contact filters is not great, and is covered mainly by the necessary gatemen, analysts, and foremen. At intervals, all the material would have to be removed from the filters, washed and replaced.

The approximate cost of building and operating a contact-filter plant with all needed appurtenances of a capacity of about 180,000,000 gallons daily to serve 1,200,000 people may be estimated as follows :—

Estimated cost of constructing contact-filter plant and appurtenances.

Intercepting sewers, pumping stations and appurtenances, including a daily capacity of 340,000,000 gallons, and rising mains.....	\$3,300,000
Septic tanks, 60,000,000 gallons' capacity, covered, includ- ing sludge, disposal facilities..	950,000
Contact filters, 300 acres, with all piping, appurtenances, office, laboratory, &c.....	6,000,000
	<hr/>
	10,250,000
Contingencies and supervision, 15 per cent....	1,537,500
	<hr/>
Total..	<hr/> <hr/> \$11,787,500

Annual Cost of Operations.

Pumping, fuel, labour and repairs....	\$200,000
Supervision, analytical and clerical assistants....	30,000
Care of septic tanks, including sludge disposal..	36,000
Care of contact filters.....	260,000
Supplies and miscellaneous..	25,000
	<hr/>
Total....	551,000

Capitalizing the operating expenses at 5 per cent per annum there is obtained \$11,020,000, which when added to the estimated construction cost makes a total sum of \$22,807,500 for the contact-filter project.

SPRINKLING FILTERS.

Sprinkling filters differ from contact filters principally in the method of application of sewage, which in our northern climates is discharged upon them in the form of spray from a series of fixed sprinkling nozzles placed about 12 or 15 feet apart. The filters are usually deeper and of somewhat coarser material than contact filters.

These filters also are an English adaptation of the Lawrence investigations made with gravel filters, some fifteen years ago. The English studies began at Salford in 1892 and have resulted in the adoption of this form of filter for many of the principal cities in England, the largest of which is the metropolitan district of Birmingham, with a population of over 900,000. Some of these filters have been in successful prac-

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tical operation for more than eight years. On the Continent, this method is being adopted for portions of the suburbs of Paris and Berlin.

In this country, this method has been studied with care at Lawrence, Mass. ; Columbus, Ohio; Boston, Mass., and Waterbury, Conn. Filters of this type are now under construction at Columbus, Ohio, and Reading, Pa. They have been recently adopted for Baltimore, Md.; West Chester, Pa., Washington, Pa., and Waterbury, Conn. They have been recommended for use also at Paterson, N.J.

The important element of aeration is secured in sprinkling filters, partly by applying the liquid as a spray and partly through the use of coarse material with voids of a size so that there is a vertical circulation of air through the filtering material at all times.

Suspended mineral and organic matters and some of the dissolved organic matters are retained upon the surface of the filtering material as the liquid passes in thin films over the surface of the particles. Bacterial activities reduce the organic matter to a material degree, and from time to time the remaining inert material cracks and peels and passes through the filter bed to the bottom. In order to be able to remove this accumulated matter, it is necessary to provide false bottoms for these filters. Filters of this type have been in successful use for more than eight years without cleaning, and it is believed that under favourable conditions cleaning is not required oftener than once in ten or fifteen years.

The amount of suspended matter in the effluent of sprinkling filters due to this unloading of stored material is sufficient to require passing the effluent through settling basins, holding about two hours' flow, before discharging into the nearest water course. The settled effluent, of satisfactory appearance and with its organic matter so reduced that it will not putrefy, usually contains less than 10 per cent of the bacteria in the crude sewage.

There is a considerable range in size of broken stone and in depth of material as adopted in various large plants now built or building. Avoiding extremes, it may be stated that the depths average about 7 feet, and the size of material ranges from about 1 to 2½ inches, mean diameter. We have assumed these figures for sprinkling filters for the Calumet area, to be built of broken stone at the sites already mentioned for contact filters, namely: west of Harvey, west of Hammond, and between Lakes Calumet and Wolf.

We have carefully considered the climatic conditions at Chicago and compared them with temperatures where practical experiences with sprinkling filters have been obtained. There is no trouble from the freezing of the sprinkler nozzles through which sewage is applied under a head of 6 or 7 feet. During the zero weather some frozen sewage accumulates on the surface of the filter and at such times it is necessary to have some reserve area. We have assumed that under these local conditions one acre of sprinkling filters should be provided for every 15,000 people connected with the sewers, making a rate ordinarily of about 2,250,000 gallons per acre per twenty-four hours. As was demonstrated at Columbus, such rates for several weeks at a time may be doubled and still obtain a satisfactory nonputrescible effluent. This rate, expressed in persons served per acre-foot of sprinkling filter material, is only about one-half of that provided for at Columbus, Ohio, and one-third of that in several plants in England.

The approximate cost of building and operating a sprinkling filter plant with all needed appurtenances, of a capacity of 180,000,000 gallons daily, to serve a population of 1,200,000 may be estimated as follows:—

Estimated cost of constructing sprinkling filter plant and appurtenances.

Intercepting sewers, pumping stations and appurtenances, including a daily capacity of 340,000,000 gallons, and rising mains.....	\$3,300,000
Septic tanks, 60,000,000 gallons' capacity, covered, including sludge-disposal facilities.....	950,000
Sprinkling filters, 80 acres, with all appurtenances, office, laboratory, &c.....	3,600,000
Settling basins, 15,000,000 gallons' capacity..	200,000
	<hr/>
	8,050,000
Contingencies and supervision, 15 per cent.	1,207,500
	<hr/>
Total.....	9,257,500

Annual Cost of Operation.

Pumping, fuel, labour and repairs.....	\$ 200,000
Supervision, analytical and clerical assistants..	30,000
Care of septic and settling tanks, including sludge disposal	54,000
Care of sprinkling filters.....	110,000
Supplies and miscellaneous.....	25,000
	<hr/>
Total..	\$419,000

Capitalizing the operating expenses at 5 per cent per annum, there is obtained \$8,380,000, which when added to the estimated construction cost makes a total sum of \$17,637,500 for the sprinkling filter subject.

CONCLUSION.

In recapitulating the substance of the foregoing inquiry and referring specifically to your instructions, summarized at the outset, we conclude as follows :—

1. The examination into the sanitary situation at Chicago, so far as it is affected by sewage disposal, revealed that since removing the sewage through the drainage canal the appearance of the water of the Chicago river has shown marked improvement. As regards the hygienic quality of the public water supply there has also been an improvement, due to the progressive elimination of sewage from the lake, which elimination should be completed within a few years.
2. The latest conclusions of sanitary engineers as to the amount of dilution which is required to make sewage inoffensive, are that a dilution of 3½ cubic feet per second for each 1,000 persons conected with the sewers, as provided for in the enactment of the Illinois legislature in 1889, is as low a figure as it is now possible to state. We believe that with the elimination of objectionable trade wastes and the occasional dredging of the river, this amount of dilution will be sufficient to prevent offensiveness.
3. The extension of the dilution method to the outlying territory is not the only way to preserve the lives and health of the people of Chicago. The application of this method with flows of 10,000 and 14,000 cubic feet per second, respectively, for the area tributary to the present drainage canal will serve populations not exceeding 3,000,000 and 4,200,000, respectively. For greater populations, other methods of sewage disposal will be required.
4. For the Calumet area, as well as other districts, there are several methods for the disposal of sewage, as effective as the present method of dilution in preventing the pollution of the lake waters.

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5. All of these methods involve intercepting sewers and pumping stations to collect and deliver the sewage at suitable sites. Septic tanks are used for partially clarifying the sewage, which may then be applied to any one of three methods of filters, viz., intermittent sand filters, contact filters and sprinkling filters.

All of these filters, if well built and well managed, remove the suspended and organic matters so that the effluents are practically clear and are non-putrescible. The removal of bacteria by these three types of filters averages at least 98, 80, and 90 per cent, respectively. Such effluents may be discharged directly into any of the water courses of the Calumet region.

6. The approximate total costs, liberally estimated, without the preparation of detailed plans, for a population of 1,200,000, are as follows :—

A.—Intermittent sand filters.

Construction...	\$11,063,000
Annual cost of operation, \$866,000, capitalized at 5 p.c..	17,320,000
	<hr/>
	28,383,000
	<hr/>

B.—Contact filters. ..

Construction...	11,787,500
Annual cost of operation, \$551,000, capitalized at 5 p.c..	11,020,000
	<hr/>
	22,807,500
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C.—Sprinkling filters.

Construction...	9,257,500
Annual cost of operation, \$419,000, capital at 5 per cent..	8,380,000
	<hr/>
	17,637,500

The present population on the Calumet area of the sanitary district being less than 200,000 would naturally require but a portion of the cost of estimated works and of their operation to be expended at the outset.

Of the available methods of disposing of the sewage of the Calumet area, other than by dilution, the sprinkling filter method, being the cheapest, both in cost of construction and of operation, and accomplishing an adequate degree of purification, is clearly the most advantageous one.

Very respectfully,

RUDOLPH HERING,
GEORGE W. FULLER.

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REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION ON THE
LOCATION OF THE BOUNDARY LINE BETWEEN THE UNITED
STATES AND CANADA THROUGH LAKE ERIE.

TORONTO, January 4, 1907.

The Honourable the Secretary of War of the United States, and the Honourable the Minister of Public Works of the Dominion of Canada :

This matter comes before the International Waterways Commission by indorsement of the Secretary of War, dated September 10, 1906, referring letters of the Acting-Secretary of State, dated September 5, 1906, and September 7, 1906, respectively. The subject matter referred is set forth in the letter of the Acting Secretary of State, dated September 5, which, after stating that the commander of the Canadian cruiser *Vigilant* had made a proposition to log and mark by buoys the exact international water boundary line on Lake Erie, thereby enabling fishermen to keep on their side of the line, and that difference of opinion exists between interested parties as to the exact location of the boundary line, asks that the matter be referred to this commission with the inquiry whether it is known that the American and Canadian charts of the locality agree as to the distance to be logged from the gas buoy at Erie to the boundary on the usual fishing ground.

After most diligent research, the commission has been unable to discover any authoritative description, map, or chart, American or British, from which the location of the boundary line on Lake Erie can be determined and laid down on modern charts, satisfactorily, except, from a point southeast of Middle island to the mouth of Detroit river and from a point near the mouth of Niagara river, northerly.

The sixth Article of the Treaty of Ghent, after stating that by the former treaty of peace, the boundary line from the point where the 45th degree of north latitude meets the St. Lawrence river, to Lake Superior, was declared to be 'along the middle of said river into Lake Ontario, through the middle of said lake, until it strikes the communication by water between that lake and Lake Erie, thence along the middle of said communication into Lake Erie, through the middle of said lake until it arrives at the water communication into the Lake Huron, thence through the middle of said lake to the water communication between that lake and Lake Superior,' and after stating that doubts have arisen as to 'what was the middle of said river, lakes and water communications, and whether certain islands lying in the same were within the dominion of His Britannic Majesty or the United States,' provides for a reference of the matter to two commissioners, who are instructed by the article to designate by a report or declaration under their hands and seals, the boundary through the said river, lakes and water communications, and to decide what islands belonged to each of the contracting parties, it being provided that the decision of the commissioners should be final and conclusive. The treaty referred to in this article is that concluded in the year 1783. By Article 11 of that treaty the boundary line of the St. Lawrence system is described as commencing at a point where the 45th degree of north latitude meets the St. Lawrence river, thence through the middle of that river and through the middle of Lake Ontario, the middle of the water communication between Lake Erie and Lake Ontario, the middle of Lake Erie, the middle of the water communication between Lake Erie and Lake Huron, the middle of Lake Huron to the water communication between that lake and Lake Superior, thence through Lake Superior northward of the Isles Royal and Phelipeaux to the Long lake. From this it follows that the commissioners were appointed to determine the middle line of all waters between

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the east end of Lake Superior and the junction of the 45th degree of north latitude with the middle line of the St. Lawrence river, in accordance with the true meaning of the Treaty of 1783.

The commissioners were appointed, and by a report, dated June 18, 1882, they described the boundary line. The description is no more definite, so far as the Great Lakes are concerned, than was the treaty of 1783 (except in Lake Erie west of Middle Island), and a similar description to that in the Treaty is adopted in the report of the commissioners when describing the boundary line in those lakes. It is impossible from the report, to lay down with accuracy the boundary line in any of the waters covered by it. The commissioners appear to have ended their labours at the foot of Neebish rapids in St. Mary's river, not agreeing as to which channel the line should follow, going north from that point. However, they filed a map showing the line from a point near the head of Sugar Island through the river to a point opposite Gros Cap and Point Iroquois, the east end of Lake Superior. In their report they state that the boundary line as determined by them 'is more clearly indicated in a series of maps accompanying their report, exhibiting a correct survey and delineation of all the rivers, lakes, water communications and islands embraced by the sixth Article of the Treaty of Ghent, by a black line shaded on the British side with red and on the American side with blue, and each sheet of which series of maps is identified by a certificate subscribed by the commissioners and by the two principal surveyors employed by them.'

The commissioners, as stated in their report, prepared certain maps to accompany it, which it is understood were filed in London and in the office of the Secretary of State at Washington with quadruplicate reports. The records of the Secretary of State of Washington disclose maps, properly authenticated by the commissioners and the surveyors, showing the boundary line through the St. Lawrence river and as far as a point near and southwesterly from Duck Islands in Lake Ontario, through Niagara river to a point in the northeasterly end of Lake Erie about north of the mouth of Buffalo creek, in the city of Buffalo, from a point near, and southeasterly from Middle Island at the southwest end of Lake Erie to the mouth of the Detroit river, through the Detroit river, through Lake St. Clair and the St. Clair river to Lake Huron, and through Lake Huron to and into St. Marys river as far as the foot of Neebish rapids, also from a point about a mile above Sugar Island through the river to a point opposite Point Iroquois in Lake Superior. There are on file in the office of the Secretary of State of the United States unauthenticated maps showing what purports to be the boundary line through Lakes Ontario and Erie. This commission has not had an opportunity to consult the maps filed in London by the commissioners appointed under the treaty, but historical research indicates that there was no map of the boundary line in Lake Ontario from near Duck Islands to the mouth of the Niagara river, and no map of the boundary line in Lake Erie from about opposite the city of Buffalo to a point near and southeast of Middle Island, authenticated by the commissioners appointed under the Treaty of Ghent; and it is clear that the commissioners did not agree upon the boundary line through Lake Superior, nor through the St. Marys river from the foot of Neebish rapids to a point near the head of Sugar Island. The maps of Lakes Huron, St. Clair and Superior are authenticated by the commissioners, but are so inaccurate that they are useless for the purpose of accurately determining the location of the boundary lines on them.

By the Treaty of Washington, ratified in 1842, Article 11, the boundary line from the point where the commissioners under the Treaty of Ghent ceased their labours, viz., at the foot of Neebish rapids, through St. Marys river and Lake Superior to Pigeon river at the westerly end of that lake, was described. In this article, maps of St. Marys river and Lake Superior are referred to as made by the commissioners under the Treaty of Ghent, and as having traced on them part of the boundary line in St. Marys river and the boundary line in Lake Superior to a point north of Isle Royale. These maps were made by the commissioners pursuant to Article VII. of the Treaty of Ghent.

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Reference to the records in the office of the Secretary of State discloses maps of the boundary line described in the Treaty of Washington, certified by the commissioners appointed under the Treaty of Ghent and by Daniel Webster, Secretary of State of the United States, and Lord Ashburten, minister plenipotentiary of Her Majesty the Queen of the United Kingdom of Great Britain and Ireland, who negotiated and signed the treaty. These maps show the boundary line from the head of Muddy lake (now known as 'Mud' lake) through the St. Marys river to a point about a mile above the head of Sugar island, and from opposite Point Irroquois through Lake Superior to the Pigeon river.

As the office of the Secretary of State of the United States is the only proper place, in the United States, for deposit of the report and maps prepared by the commissioners appointed under the provisions of the Treaty of Ghent, the Commission concludes that there is no authoritative delineation of the boundary line through Lake Erie in existence unless a properly certified map was filed in London by the commissioners and is to be found there now. The commission would, however, suggest that as the dimensions of the Great Lakes and the contour of their shores had not been ascertained with any accuracy at the time the commissioners appointed under the Treaty of Ghent acted, it is highly improbable that any map prepared by them would be sufficient for the purpose of laying down the boundary line upon modern charts. The map of Lake Erie, on file in the office of the Secretary of State is an illustration; it plainly discloses that the dimensions of that lake and the contour of its shores were not known at the time it was prepared, for the lake itself appears on the map to be about eighteen miles too long, and, in one place, to be about sixteen miles wider than it actually is, with an average excess width of about six and a half miles; that is, its dimensions are so distorted that the location of the boundary line delineated upon it cannot be accurately ascertained and cannot be laid down upon modern charts without proceeding upon suppositions upon which it would be difficult or impossible to secure agreement by different engineers. The inaccuracy of this map is illustrated further hereafter.

There are in existence two official maps of Lake Erie which show a boundary line. These are, a chart prepared by the British Admiralty and a chart prepared by the Hydrographic office, Bureau of Navigation, Department of the Navy of the United States. The boundary lines as laid down upon these maps vary greatly from each other and neither one is so far authoritative as to be binding upon the United States and the Dominion of Canada. The British Admiralty map is projected, upon the polyconic system, the scale being 1 to 400,000 approximately, the Hydrographic chart being laid down on Mercator's projection.

The difficulty in ascertaining the exact location of the boundary on Lake Erie, from a point opposite Buffalo to the point near Middle Island, arises from the language of the Treaties of 1783 and 1814, as well as the language adopted in their report by the commissioners appointed under the latter treaty.

All these instruments define the boundary line as passing through 'the middle' of the lake. The expression used is subject to various interpretations :

It may mean :—

- (a) A line being at all points equally distant from each shore.
- (b) A line following the general lines of the shores and dividing the surface water area as nearly as practicable into two equal parts.
- (c) A line along the mid-channel dividing the navigable portion of the lake, and being at all points equally distant from the shoal water on each shore.

It is to be observed that if the second interpretation above mentioned be adopted as governing the location of the boundary line, a question will arise, probably capable of being adjusted by compromise, as to how far the location of the line, 'following the general lines of the shores' would be affected by the projection known as Long Point.

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It is also to be observed that it may be possible to establish a line which would not greatly differ from the lines which would result from the adoption of any of the above suggested interpretations and which would consist of the fewest possible number of straight lines. The great advantage of such a boundary is manifest as enabling fishermen and navigators to locate it with accuracy.

A line can be delineated upon modern charts, by agreement between the United States and Great Britain, so as to carry out the spirit of the Treaties of 1783 and 1814, accomplish a just division of the lake and present a practical boundary consisting of a few straight lines, the location of which at any point can be accurately ascertained when necessary, and which will not be confusing to fishermen or navigators. In the opinion of the commission such a boundary is the proper one, but no engineer can project it upon modern charts until it has been settled by a joint commission, inasmuch as it is possible to place several lines upon a modern chart, differing very considerably from each other.

Accurate charts of the Great Lakes, projected on the polyconic system upon a scale of 1 to 400,000, have been issued by the United States Lake Survey, and the commission, for the purpose of illustrating the difficulties in the way of ascertaining and delineating the boundary line on Lake Erie, has caused that line as laid down by the British Admiralty, together with the line as delineated by the Hydrographic Survey Office, to be drawn on the Lake Survey chart which accompanies this report and is marked 'A.'

To illustrate the absolute unreliability and inaccuracy of the map of Lake Erie on file in the office of the Secretary of State of the United States, the commission has prepared a copy thereof upon a reduced scale, which, by superposition upon the chart marked 'A,' will disclose the distortion of the lake's dimensions and the impossibility of reproducing upon the Lake Survey chart the boundary line as it appears on that map. This reduced map accompanies our report and is marked 'B.' It is projected upon the same system and as nearly as possible upon the same scale as chart 'A.' Map 'B' discloses that at the time it was made, the contour of the south shore of Lake Erie was pretty accurately known, but that knowledge of the north shore was very general, for, by placing map 'B' on chart 'A,' the south shore-line can be made to very nearly correspond, but, this being done, the north shore-line appears greatly out of place. The southwest end of Lake Erie was surveyed by the commissioners appointed under the Treaty of Ghent and consequently approaches correctness, but the boundary line at that end of the lake as delineated on the filed map of the entire lake cannot be made to correspond with that on the certified map of the southwest end. The map of the entire lake is, in fact, utterly worthless and cannot be used for the purpose of locating the boundary on chart 'A.'

Comparison of the Hydrographic and British Admiralty boundary lines, laid down upon their respective charts as transferred to the Lake Survey chart, shows very great discrepancies; they cross and recross each other, disclosing in some places conflicting jurisdiction, and in other places what appears to be neutral territory, over which neither country would have jurisdiction. In one place, southeast of Long Point, the line on the Hydrographic chart is about eight miles farther north than on the British Admiralty chart, showing conflicting jurisdiction, while at another point, southwest of Long Point, there is quite a long space between the lines, the Hydrographic line being about two miles south of the British Admiralty line at the widest point, thus apparently leaving a very considerable area not within the jurisdiction of either country. If we superpose map 'B' on chart 'A,' we find still further confusion, inasmuch as the shore line of Lake Erie as shown on map 'B' cannot be made to correspond with the shore-line on chart 'A.' No engineer is capable of reconciling these different lines upon any theory presented by the description in the Treaty of 1783, or by the Treaty of Ghent, or by the report of the commissioners appointed under the last named treaty, as those descriptions simply place the boundary line in 'the middle' of the lake. Interpretations of these descriptions by engineers will vary in accordance with the theories which they may adopt.

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All the authentic maps of the lakes and the water communications between them, and of the St. Lawrence, are subject to the general criticism, that while most of the rivers were surveyed, and an attempt was made to lay down the boundary line on them and on the lakes, the maps do not represent present conditions with sufficient accuracy to prevent serious disagreement between surveyors who might attempt to delineate the boundary line on modern and accurate charts, and the lines surveyed were not sufficiently marked.

CONCLUSION.

The commission therefore concludes :

1. That the international boundary line on Lake Erie cannot be ascertained with any accuracy from existing data.

2. That the American and Canadian charts of Lake Erie, namely, the Hydrographic and British Admiralty charts, do not agree as to the distance to be logged from the gas buoy at Erie to the boundary line on the usual fishing ground.

RECOMMENDATIONS.

The commission would respectfully recommend :

1. That the entire boundary line from the point where the 45th parallel of north latitude meets the middle of the St. Lawrence river, through that river, the Great Lakes and connecting waters, in accordance with the true intent and meaning of the Treaties of 1783, 1814 and 1842, be located to accord as nearly as possible with the lines fixed by the commissioners appointed under the Treaty of Ghent, and the Treaty of 1842, be delineated upon modern charts, and be so described by reference to fixed monuments, where necessary, that it can in the future be relocated at any given point by survey.

2. That the location, delineation on modern charts and monumenting of the boundary line, proceed under the direction of this commission or another international commission to be appointed, and that when it is located, laid down on modern charts and monumented, that it be finally fixed and determined by treaty accordingly.

3. That this commission be authorized to locate, lay down upon a modern chart and monument the boundary line through Lake Erie.

All of which is respectfully submitted.

O. H. ERNST,
Brigadier-General, U.S. Army (retired),
Chairman, American Section.

GEO. C. GIBBONS,
Chairman, Canadian Section.

GEO. CLINTON,
Member American Section.

W. F. KING,
Member, Canadian Section.

E. E. HASKELL,
Member, American Section.

LOUIS COSTE,
Member, Canadian Section.

ATTEST :

W. E. WILSON,
Secretary, American Section.

ATTEST :

THOS. COTE,
Secretary, Canadian Section.

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AMERICAN SECTION—SECOND PROGRESS REPORT—DECEMBER 1, 1906.

INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF CHAIRMAN AMERICAN SECTION,
ROOM 328, MILLS BUILDING ANNEX.
WASHINGTON, D.C., November 27, 1906.

Mr. SECRETARY : 1. The American members of the International Waterways Commission have the honour to submit the following progress report covering their work during the year ending December 1, 1906 :—

ORGANIZATION.

2. The commission suffered a very serious loss in the death at Detroit, on July 3 last, of Mr. George Y. Wisner, one of its most valued members. At its meeting in Toronto, July 24, it passed the following resolution, viz.:—

Resolved, That the members of the International Waterways Commission have heard with profound regret of the decease of their colleague, George Y. Wisner, Esq., on July 3, at Detroit, Mich. In the death of this eminent engineer the commission has lost an able adviser and a valued associate. Upon the great experience and acquirements of Mr. Wisner the commission always felt it could rely; his fairmindedness it has never doubted, and his devotion to his duties has ever assured his full and able performance of his duties as a commissioner. To his widow and family we extend our most sincere sympathy.

Mr. Wisner's place upon the commission was filled by the appointment of Mr. Eugene E. Haskell, dean of the civil engineering department of Cornell University. The secretary of the American section, Mr. L. C. Sabin, resigned in August to accept the position of superintendent of the Sault Ste. Marie Canal. He was succeeded by Mr. W. E. Wilson.

3. A change occurred also in the Canadian membership. Under date of November 18, 1905, Mr. J. P. Mabey was appointed judge of the Supreme Court of Judicature for Ontario, justice of the High Court of Justice of Ontario, and a member of the Chancery Division of the said High Court of Justice. He was succeeded as Chairman of the Canadian section of this commission by George C. Gibbons, Esq., of London, Ont.

4. The full commission has held eight, and the American section twelve, meetings during the year at Buffalo, Niagara Falls, Toronto, Chicago, and Washington, the sessions lasting from one to three days each. In the intervals between the meetings the collection and study of the data bearing upon the various questions before the commission were continued.

NIAGARA FALLS.

5. A joint resolution was passed by Congress, approved March 15, 1906, calling upon the American members 'to report to Congress at an early date what action is, in their judgment, necessary and desirable to prevent the further depletion of water flowing over Niagara Falls; and the said members are also directed to exert, in conjunction with the members of the said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of said Niagara Falls in their natural condition.' The American members submitted a report dated March 19, 1906, which was forwarded by the Secretary of War, March 20, 1906, to the President, who submitted it to Congress with his message of March 27, 1906. It was published as Senate document No. 242, Fifty-ninth Congress, first session. It was

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subsequently concurred in substantially by the Canadian members, and the joint report of the full commission dated May 3, 1906, was forwarded to Congress by the President with his message of May 7, 1906, and was published as Senate document No. 434, Fifty-ninth Congress, first session.

6. The report of March 19 was followed by an exhaustive investigation of the subject by the Rivers and Harbours Committee of the House of Representatives, who, during several weeks, held public hearings at Washington, at which all persons interested were given an opportunity to be heard, and who sent a subcommittee to Niagara Falls, where a thorough inspection of the works was made, and where also there was a public hearing. The result was a confirmation of the report in all essential particulars.

7. An 'Act for the control and regulation of the waters of Niagara River, for the preservation of Niagara Falls, and for other purposes,' approved June 29, 1906, was then passed by Congress. It authorizes the Secretary of War to grant permits for the diversion of water on the American side, and for the transmission of electrical power from Canada, under certain prescribed conditions and to certain prescribed limits. The total amounts authorized being considerably less than the amounts applied for by the power companies, a more detailed investigation, which should embrace particularly the commercial and financial side of the power-producing industry at Niagara Falls, became necessary to insure an equitable division of the amounts authorized. Capt. Charles W. Kutz, Corps of Engineers, U.S. Army, was detailed by the honorable Secretary of War to make the investigation. Four kinds of permits are authorized in the law. On August 15 he submitted a report upon permits for the transmission of electrical power to the United States from Canada, which was reviewed by us in our report dated September 29, 1906. On October 5 he submitted a report upon permits for the diversion of water on the American side, which was reviewed by us in our report of November 15, 1906.

CHICAGO DRAINAGE CANAL.

8. Any discussion of the preservation of Niagara Falls would have been incomplete without some reference to the Chicago Drainage Canal, which was designed to divert from the southern end of Lake Michigan 10,000 cubic feet per second of water naturally tributary to the falls. A discussion of the effect of such diversion upon water levels, and consequently upon the navigation interests of the Great Lakes and of the St. Lawrence Valley, could find no proper place in the Niagara Falls report. In recommending the allowance of 10,000 cubic feet per second to the Chicago Drainage Canal the commission ignored those important questions. It believed, in so doing, that it was accepting a general tacit agreement that some such amount was required to protect the health of Chicago, and that the city should have it without further question, whatever the effect upon navigation might be. It believed also that the amount was all that Chicago asked or desired. It turns out that in this latter respect it was mistaken. Plans are on foot at Chicago which calls for a much larger amount at present and for amounts in the future to which no limit is assigned. The commission has collected a large amount of information upon the subject and has held public hearings at Buffalo and Chicago, but its investigations are not entirely completed. It will at an early day submit a full report upon the subject.

SAULT STE. MARIE.

9. On May 3 the commission submitted to the two governments a joint report upon the conditions existing at Sault Ste. Marie, in which were the following recommendations, viz.:—

1. That no permits shall be granted for the use of the waters of St. Marys River, or for the erection of structures in, under, or over, or the occupation in any manner of, the said waters until plans have been submitted to the commission for its investi-

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gation and recommendation, and the use of the waters under such permits shall not be allowed except upon compliance with the rules hereinafter recommended.

2. The commission further recommends that no grants, permits, or concessions should be made, which directly or by operation of law, may, in any manner, affect the right of the United States or Canada, to control the bed of the St. Marys River, below high-water mark, and especially that none should be made which, legally or equitably, may be the means of adding to the expense of acquiring lands or rights for the purpose of making improvements in aid of navigation, or which may give an equitable right to compensation in case of the removal of structures in said river.

3. That steps be taken to increase the lockage facilities at the Sault Ste. Marie without unnecessary delay.

4. That the governments of the United States and Canada reserve all water necessary for navigation purposes, at present or in the future, and the surplus shall be divided equally between the two countries for power purposes.

5. As the commission regards the interests of the United States and Canada in the preservation of the lake levels, and in the improvement of the channels and the conservation of the water supply for purposes of navigation as identical and as incapable of efficient protection without joint and harmonious action on the part of the two governments, it recommends that the rules hereinafter set forth be adopted, and that a joint commission be created to supervise their enforcement, or that such powers be vested in the existing International Waterways Commission, subject to such restrictions and reservations as may be deemed advisable.

The report was approved by the honourable Secretary of War and by him transmitted to the honourable Secretary of State with the following endorsement, dated May 14, 1906, viz.:—

Respectfully referred to the Secretary of State with a request that after the report be read it be forwarded to the President as a basis for negotiations looking to the adoption of a treaty carrying into effect the recommendations of the International Waterways Commission, the report of which is approved so far as this department is concerned.

Embodied in the report were a series of rules and regulations to govern the use of water at the Sault. As the enforcement of these rules involves the creation of a permanent international commission, they have not as yet been put in force. It is to be presumed that provision for a permanent commission will be arranged in a treaty.

A full copy of the report is already published.

MINNESOTA CANAL AND POWER COMPANY.

10. The Minnesota Canal and Power Company, a corporation organized under the laws of Minnesota, proposes to construct reservoirs in the Birch Lake basin in Minnesota, in which water is to be stored, and from which it is to be released as needed, and conducted by artificial and natural channels southward to Duluth, where it is to be employed for generating electrical power. The natural drainage of the Birch Lake basin is northward into the Rainy river, Lake of the Woods, Winnipeg river, Winnipeg lake, and finally into the Hudson bay; the water thus forming a part of the international boundary and finally entering territory which is exclusively Canadian. The company applied to the Department of the Interior for permission to use certain public lands by flowage and otherwise. The attention of the commission was drawn to the matter immediately after its organization, as was stated in our last annual report, but the commission had at that time doubts about its jurisdiction in the case, inasmuch as the waters were not naturally tributary to the Great Lake system. This doubt was dispelled by a letter from the honourable Secretary of State to the honourable Secretary of War, dated May 14, 1906, in which he requested that the matter be referred to the commission.

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DEPARTMENT OF STATE,

WASHINGTON, May 14, 1906.

SIR,—I have the honour to inclose herewith copy of a letter from the Secretary of the Interior with reference to correspondence had with this department relative to the application of the Minnesota Canal and Power Company for right of way privileges in the State of Minnesota, under the provisions of the Act of February 15, 1901 (31 Stat., 790).

Inviting attention to the second paragraph of Mr. Hitchcock's letter, I have the honour to request that the matter be referred to the International Lake Levels Commission for an expression of its views.

I have the honour to be, sir, your obedient servant,

ELIHU ROOT.

The Honourable the Secretary of War.

11. After several public hearings and a careful examination of all the documents in the case, the number of which is very great, the commission rendered a joint report to the two governments, dated November 15, 1906 (copy appended marked 'C,' in which are the following conclusions and recommendations, viz :—

1. While the work proposed by the applicant will be of great advantage to the interests served, it will interfere with public and private interests in Canada, and the commission see no public necessity for it.

2. The proposed diversion will injure the interests of various classes of persons, namely, residents of the United States having property rights in the State of Minnesota, residents in the United States having property rights and interests in Canada and in the boundary waters, residents of Canada having property rights and interests in Canada, and municipalities in the Dominion of Canada. The rights and interests which will be affected are divisible into two classes, namely, those which depend upon navigation directly or indirectly, and those which depend upon the use of waters of the various streams and lakes for power purposes.

3. The proposed diversion will affect injuriously navigation upon the boundary waters between the United States and Canada, above mentioned, and upon navigable waters in Canada connecting said boundary waters; but

4. So far as water-power interests on the international boundary or in Canada are concerned, which depend upon the supply from Birch lake drainage area, although remedial works at locations above Rainy River may be constructed, the total amount of water which can be stored and used for power purposes upon the boundary and connecting waters located wholly in Canada will be diminished.

5. The applicant, the Minnesota Canal and Power Company, of Duluth, Minn., under the decision of the supreme court of Minnesota, above cited, apparently has not the power to utilize the permit it seeks to obtain, but possibly may acquire that power. It would seem, therefore, that the permit which the applicant seeks, ought not in any case to be granted before it secures authority under the laws of Minnesota to utilize it.

6. That the rights and interests of the residents of Minnesota which may be affected by the proposed diversion, are of so much less importance than the interests which will be promoted by the proposed works of the applicant, that they do not furnish a sufficient reason for refusing the permit sought, inasmuch as full compensation must be made to such persons under the laws of Minnesota.

7. Neither the State of Minnesota nor the United States can provide adequate means by which money compensation can be ascertained and made to the owners of the interests in Canada which may be injured, and it follows that individuals sustaining injury would be relegated to litigation. This is a violation of the principle of law that private property shall not be taken for public use, unless provision for compensation can be made without litigation and its attendant delays and expense.

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8. So far as remedial works are concerned, it is sufficient to say that there is no jurisdiction in the United States or in the State of Minnesota to provide for or permit the erection of the necessary remedial works in Canada.

9. That although it might be advisable to grant the permit applied for, in case the applicant should acquire the powers necessary to utilize it, if objections arising from international relations did not exist, treaty provisions, international comity, and the impossibility of providing just means of assuring adequate compensation for injury to interests in Canada, or of preserving navigation unimpaired on the boundary streams, without concurrent action of both governments concerned, lead us to the conclusion that the permit should not be granted unless the full protection of all interests not cared for by the laws of Minnesota, be secured by concurrent action of the United States and Canada.

1. The commission would therefore recommend that the permit applied for be not granted without the concurrence of the Canadian government.

2. As questions involving the same principles and difficulties, liable to create friction, hostile feelings, and reprisals, are liable to arise between the two countries, affecting waters on or crossing the boundary line, the commission would recommend that a treaty be entered into which shall settle the rules and principles upon which all such questions may be peacefully and satisfactorily determined as they arise.

3. The commission would recommend that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be :

(a) Use for necessity domestic and sanitary purposes.

(b) Service of locks used for navigation purposes.

(c) The right to navigate.

4. The commission would also respectfully suggest that the treaty should prohibit the permanent diversion of navigable streams which cross the international boundary or which form a part thereof, except upon adjustment of the rights of all parties concerned by a permanent commission, and with its consent.

RICHELIEU RIVER AND LAKE CHAMPLAIN.

12. The International Development Company, a corporation organized under the laws of Canada, proposes to deepen the Richelieu river and regulate its flow so that there shall be a uniform discharge of at least 9,000 cubic feet per second throughout the year. For this purpose it proposes to use Lake Champlain as a reservoir, in which the surplus water is to be stored during the wet season, and from which it is to be released as needed during the low water period. The works are to be located in Canadian territory, but the company desiring to ascertain the probable attitude toward them of the United States government, submitted to the War Department a preliminary statement, without plans, showing in general what it proposed to accomplish. The matter was referred to the International Waterways Commission by indorsement of the honourable Secretary of War, dated November 6, 1906. The commission found that a uniform flow of 9,000 cubic feet per second could not be maintained at all seasons and in all years without giving to Lake Champlain a range, between extreme high and extreme low water, which they deemed inadmissible; but that it would be possible to plan works which would not injuriously affect Lake Champlain and would materially improve the conditions of the flow in the Richelieu river.

Under date of November 15, 1906, it submitted a joint report to the two governments, from which the following is an extract, viz.:—

As Lake Champlain is wholly within the territory of the United States, and the proposed works are wholly within Canadian territory, the international questions raised are of some moment. It is, in our opinion, not desirable that either nation should obstruct the natural flow of streams crossing the international boundary to

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the injury of public or private rights in the other. It is manifest, therefore, that the applicants should furnish conclusive evidence that private rights in the states of New York and Vermont adjoining Lake Champlain will not be injuriously affected by the alteration of the lake level as proposed, and that as the Secretary of War of the United States has control of the interests of navigation on Lake Champlain, the said work should not be undertaken without his permission, and should be operated under such regulations as he may direct, with a view to the maintenance of the level of the said lake as the interests of navigation thereon may require. It would be possible to plan works adapted to the conditions, and in our opinion such works should be permitted, provided they do not interfere with private interests in the United States and meet with the approval with the Secretary of War as suggested. We respectfully submit that in any treaty to be had between the two nations in relation to the use of international waters the principles above suggested should have consideration. We would further suggest that the applicant's Canadian Act of incorporation should be amended so as to provide that the maintenance of the works sought to be erected shall be conditional at all times upon compliance with all regulations imposed by the Secretary of War of the United States of America from time to time for the preservation of the levels of Lake Champlain.

INTERNATIONAL BOUNDARY IN LAKE ERIE.

13. In August last a large number of nets were placed in Lake Erie by the Keystone Fish Company, of Erie, Pa., near the middle of the lake, but on what they claim is the American side of the boundary. Most of these nets were promptly seized and confiscated by the Canadian vessel *Vigilant*...The commander of the *Vigilant* then proposed to the American fishermen to show them the boundary, and aid them in marking it with buoys, so that they might always remain on their own side of the line if they desired to do so. The proposal was forwarded to the honourable Secretary of State and by him to the honourable Secretary of War, under date of September 5, 1906, with the request that it 'be referred to the International Waterways Commission with the inquiry whether it is known that the American and Canadian charts of the locality agree as to the distance to be logged from the gas buoy at Erie to the boundary line on the usual fishing grounds.'

14. It has been necessary to reduce the various charts upon which the boundary is marked to the same system of projection and the same scale in order to compare them, and this has required much time. The British Admiralty chart and the United States Lake Survey chart are projected on the polyconic system; the Hydrographic chart issued by the United States Navy Department is projected upon the Mercator system; while the chart on file in the State Department with the Treaty of Ghent, as near as can be ascertained, is on the plane rectangular system; with one exception, each is of a different scale from any other. It is found that the boundary as laid down on the United States Hydrographic chart differs widely from that on the British Admiralty chart. They both derive their authority from the Treaty of Ghent. The map on file with the treaty is so inaccurate that no two persons would probably transfer the boundary line marked thereon to a modern chart in the same way. It is, in fact, worthless for its purpose. The only guide for the location of the boundary in Lake Erie, except at the eastern and western extremities, is in the expression in the text of the treaty 'through the middle of the said lake.' Under that description a variety of lines may be laid down. The commission expects to complete and forward its report upon the subject at an early day.

DETROIT RIVER TUNNEL.

15. The plans of the Detroit River Tunnel Company for the construction of a tunnel under the Detroit river having been referred to the commission, it passed at its session of March 7, 1906, at Toronto, the following resolution, viz. :—

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'That the International Waterways Commission approve of the plans of the construction of a tunnel under the Detroit river prepared by the Detroit River Tunnel Company, and submitted to the commission by the Chief of Engineers of the United States Army under date of February 13, 1906, and by the Minister of Marine and Fisheries for Canada under date of November 16, 1905, the construction to be carried on on the American side under the regulations contained in the report of the Board of Engineers of the United States Army of date, January 26, 1906, and that the same be carried on on the Canadian side under regulations to be fixed by the Minister of Public Works and the Minister of Marine and Fisheries.'

SUMMER RESORT NEAR LONG SAULT RAPIDS.

16. Under date of May 28, 1906, Mr. Smith L. Dawley, of Ogdensburg, N.Y., addressed a letter to the honourable Secretary of War applying for permission to construct dikes, retaining walls and such other structures in the River St. Lawrence, near Long Sault Island, as should be necessary to create an 'attractive summer resort with navigable approaches thereto and the development of a water-power.' By indorsement, dated June 2, 1906, the paper was referred to the commission. It was not accompanied by any plans, but had with it a rough sketch upon a small-scale chart with a meagre written description which did not conform to the chart. The commission, not having information at hand sufficient to justify a recommendation, promptly notified Mr. Dawley of the deficiency and requested him to provide it with a complete description of his plans. This has not as yet been done.

BUFFALO INLET PIER.

17. At its session in Buffalo on the 26th of June representatives of the city appeared before the commission, and requested its approval of the location of a new inlet pier for the city waterworks, which it was desired to place in the international waters on the Canadian side of the boundary. Although the question had not been regularly brought before it by higher authority, the commission thought it proper, with a view to avoiding delay, to pass the following resolution, viz. :—

'That in the opinion of the International Waterways Commission, the tunnel and inlet pier proposed to be constructed in Lake Erie by the city of Buffalo, for the purpose of furnishing a pure water supply to the city, can be built without injury to navigation or other public interests, and it is recommended that permits for the construction of these works be granted, with the proviso that the inlet pier be kept properly lighted at night at the expense of the city.'

MASSENA WATER POWER COMPANY.

18. Under date of April 4, 1906, the Calvin Company, Limited, addressed a letter to the Minister of Public Works of Canada, protesting against the closure by a dam of the south channel at Long Sault Island, which it understood was contemplated by an American corporation. This letter was referred to the commission. A work such as that described could not be constructed without permission from the War Department of the United States. It was found that no permit had been granted, and that no application for one was at that time pending.

REGULATION OF LAKE ERIE.

19. Much study has been given to this important problem, but the commission is not as yet prepared to report upon it. A large amount of new data has recently been collected by the office of the United States Lake Survey at Detroit, of which a careful study is necessary to a proper solution of the question.

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LEGISLATION SUGGESTED.

20. Under the law of Congress creating the commission, its jurisdiction is limited to the waters whose natural outlet is by the River St. Lawrence to the Atlantic ocean. The Canadian government has from the beginning desired that the commission should consider all questions which may arise concerning the international waters from the Atlantic to the Pacific. To enable the American members to do this, further legislation by Congress is necessary. It would seem proper to comply with the wishes of the Canadian government in this respect.

Yours respectfully,

O. H. ERNST, *Chairman*,
GEORGE CLINTON, *Member*,
E. E. HASKELL, *Member*.

Hon. WM. H. TAFT,
Secretary of War, Washington, D.C.

At page 97 and following pages, will be found the detail correspondence.

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REPORT OF THE AMERICAN SECTION ON THE PRESERVATION OF
NIAGARA FALLS.

Message from the President of the United States, transmitting the Report of the American Members of the International Waterways Commissions, with letters from the Secretary of State and the Secretary of War, including Memoranda regarding the Preservation of Niagara Falls.

March 27, 1906.—Read ; referred to the Committee on Foreign Relations and ordered to be printed.

To the Senate and House of Representatives :

I submit to you herewith the report of the American members of the International Waterways Commission regarding the preservation of Niagara Falls. I also submit to you certain letters from the Secretary of State and the Secretary of War, including memoranda showing what has been attempted by the Department of State in the effort to secure the preservation of the falls by treaty.

I earnestly recommend that Congress enact into law the suggestions of the American members of the International Waterways Commission for the preservation of Niagara Falls, without waiting for the negotiation of a treaty. The law can be put in such form that it will lapse, say in three years, provided that during that time no international agreement has been reached. But in any event I hope that this nation will make it evident that it is doing all in its power to preserve the great scenic wonder, the existence of which, unharmed, should be a matter of pride to every dweller on this continent.

THEODORE ROOSEVELT.

The WHITE HOUSE, March 27, 1906.

DEPARTMENT OF STATE,
WASHINGTON, March 24, 1906.

DEAR MR. PRESIDENT,—I return the letter of the Secretary of War with the report of the American members of the International Waterways Commission, regarding the preservation of Niagara Falls.

I think the legislation recommended by the commission would be very useful.

Faithfully yours,

ELIHU ROOT.

WAR DEPARTMENT,
WASHINGTON, March 20, 1906.

MY DEAR MR. PRESIDENT,—I herewith transmit, for submission by you to Congress, the report of the American members of the International Waterways Commission, made by them in accordance with the joint resolution approved March 15, 1906,

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and set out in their report. The recommendations of the commission of legislation necessary and desirable to prevent the further depletion of water flowing over the Niagara Falls suggests the question whether such legislation is within the limitations of the legislative power of Congress, when applied to non-navigable parts of a stream which is within the borders of a state and which is only partly navigable, if the use of the water to be inhibited does not affect navigation in the navigable part of the stream below. It would seem that the treaty power exercised by the President and Senate with respect to a stream which forms the boundary between this country and another, would be subject to less limitation in this regard than the legislative power of Congress, and therefore that it might be more advisable to effect the result sought by Congress through a treaty than through a statute.

Very respectfully,

WM. H. TAFT,
Secretary of War.

The PRESIDENT.

REPORT OF THE AMERICAN MEMBERS OF THE INTERNATIONAL WATERWAYS COMMISSION REGARDING THE PRESERVATION OF NIAGARA FALLS.

INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF CHAIRMAN AMERICAN SECTION,
WASHINGTON, D.C., March 19, 1906.

SIR,—1. The American members of the International Waterways Commission have the honour to submit for transmittal to Congress this report, in compliance with the following joint resolution approved March 15, 1906 :—

‘Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the members representing the United States upon the International Commission created by section four of the River and Harbour Act of June thirteenth, nineteen hundred and two, be requested to report to Congress at an early day what action is in their judgment necessary and desirable to prevent the further depletion of water flowing over Niagara Falls ; and the said members are also requested and directed to exert, in conjunction with the members of said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of the said Niagara Falls in their natural condition.’

2. The surplus waters of Lake Erie are discharged through the Niagara river into Lake Ontario, the mean level of Lake Erie being 572.86 feet and that of Lake Ontario being 246.61 feet above the sea. Leaving Lake Erie at Buffalo, the river is navigable and flows with a moderate slope to a short distance below Welland river, or Chippewa creek, about 19 miles, in which distance it has a fall of about 14 feet. The slope here is suddenly increased and the river ceases to be navigable. In the next half mile it has a fall of about 50 feet, forming the rapids above the falls. It is divided by Goat Island into two arms of unequal size, that on the Canadian side carrying about seven times the volume of water carried by that on the American side. At the foot of Goat Island the waters of both arms plunge over a vertical precipice, constituting Niagara Falls proper, that on the Canadian side being usually known as the Horseshoe Fall, and that on the American side as the American Fall. The height of the Horseshoe Fall is about 161 feet, and that of the American Fall 165 feet. Immediately below the falls the river is again navigable for a short distance, and then assumes the character of rapids as far as Lewiston, 7 miles from Lake Ontario, where it again becomes navigable and remains so until it enters the lake.

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3. The volume of water flowing varies with the level of Lake Erie, which level is subject to variations of several feet, depending upon the rainfall, barometric pressure, and direction and force of the wind. At the mean level of the lake (elevation 572.86) the volume of discharge is 222,400 cubic feet per second. At a very low stage (elevation 571) the volume is 180,800 (see Annual Report, Chief of Engineers, U.S. Army, for 1900 p. 5361. For short periods in midwinter or with prolonged adverse winds, it has sometimes been even less.

4. It is the great volume of water in the falls themselves and in the rapids which makes the place unique. The tremendous display of power in wild turbulence fascinates the mind, and gives to the question of Niagara's preservation a national interest.

5. The local authorities on both sides of the river have recognized their responsibilities in this matter, but have taken somewhat different views as to what these responsibilities are. As long ago as 1883 the state of New York provided for the acquisition of the lands in that state adjoining the falls, with a view to creating a public park, and in 1885 it declared that these lands 'shall forever be reserved by the state for the purpose of restoring the scenery of the falls of Niagara to and preserving it in its natural condition, they shall forever be kept open and free of access to all mankind without fee, charge or expense to any person for entering upon or passing to or over any part thereof.' A commission of five was created to carry out the purposes of the Act. The state reservation now includes 412 acres, part of which is under water, and an annual appropriation of some \$25,000 is made for its care and maintenance. The commission has no jurisdiction beyond the limits of the reservation, but it has never throughout its existence failed to protest and bring all its influence to bear against the depletion of the falls by the abstraction of water above and beyond the limits of the reservation. Nevertheless, the state legislature has granted numerous franchises for the diversion of water, as will appear further on.

6. Soon after the creation of the New York state reservation a public park was created on the Canadian side, called the Queen Victoria Niagara Falls Park, and was placed under the control of five commissioners. This park now extends practically the whole length of the Niagara river from Lake Erie to Lake Ontario, and embraces an area of about 734 acres. By an Act of the Ontario legislature (62 Victoria, cap. 11), it was enacted that 'the said commissioners, with the approval of the lieutenant-governor in council, may enter into an agreement or agreements with any person or persons, company or companies, to take water from the Niagara river or from the Niagara or Welland rivers at certain points within or without the said park for the purpose of enabling such person or persons, company or companies, to generate within or without the park electricity, or pneumatic, hydraulic or other power conducting or discharging said water through and across the said park or otherwise in such manner, for such rentals, and upon such terms and conditions as may be embodied in the agreement or agreements and as may appear to the lieutenant-governor in council to be in the public interest.' In 1903 this Act was amended by adding thereto the words 'but no such agreement shall be operative unless and until ratified and confirmed by the legislative assembly' (3 Edward VII., chap. 7). Inasmuch as the park receives no aid from the legislature in the way of annual appropriations for its support, the commissioners have felt justified in using with some freedom the power thus granted in order to obtain a revenue for the general improvement and maintenance of the park. Prior to the amendment of 1903, they entered into four important agreements for the diversion of water, and caused an investigation to be made as to the availability of additional sites for power works. Two of these agreements were with a single corporation, which has thus far utilized only one.

7. The great water power available at Niagara Falls naturally attracted the attention of engineers at an early day, but it was not until it could be transmitted and used in the form of electricity that its development on a large scale became finan-

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cially practicable. There are now five principal corporations engaged in furnishing or preparing to furnish electricity for commercial purposes, obtained from the water-power, two of them located on the American and three on the Canadian side. A brief description of each is here given. A map showing their location is submitted herewith. It is to be remarked that none of the diversions have been sanctioned by the United States government.

8. *I. Niagara Falls Hydraulic Power and Manufacturing Company.*—This company was organized in 1877 under the general laws of the state of New York. It purchased a canal which had been constructed before the civil war, leading from Port Day, above the falls, through the city of Niagara Falls, to the edge of the cliff below the falls, where a grist mill had been established. (See map.*) The length of this canal was about 4,400 feet, its width 36 feet, and its depth 8 feet. A width of 70 feet and depth of 10 feet had been projected. In 1881 the company established its first station for supplying electricity for lighting, this being the first public distribution for commercial purposes of electricity derived from Niagara Falls. The increasing demand for electricity and the improved methods of transmitting it led to a steady development of the works of this company and to the establishment of others. In 1895 an important enlargement of the canal having been begun, the right of the company to take water from the river was questioned by the commissioners of the state reservation at Niagara. An opinion was obtained from the attorney general of the state of New York (copy appended marked 'A') in which it was held that the Niagara river is a navigable river in law, that the company had no right to increase the capacity of its canal, that it had no right to divert any water from the river, and that a diversion of water sufficient to diminish the flow over the falls was a nuisance and could be restrained.

The New York legislature thereupon passed an Act (chap. 968, laws of 1896), in which the right of the company 'to take, draw, use, and lease and sell to others to use the waters of Niagara river for domestic, municipal and sanitary purposes, and to develop power therefrom for its own use and to lease and sell to others to use for manufacturing, heating, lighting and other business purposes, is hereby recognized, declared and confirmed.' No limit as to the time during which these rights were to exist was fixed, but the amount of water to be taken was limited to that which could be drawn by a canal 100 feet wide, with such depth and slope as would maintain at all times a depth of 14 feet. The amount of water thus described is not specific. It is computed to be about 9,500 cubic feet per second for the works now under construction, but it would be possible to construct works under different plans which would use a much greater quantity of water. The company is now using about 4,000 cubic feet per second. It is extending its works, and expects to develop about 134,000 horse-power, in addition to which its tenant companies will develop about 8,000 horse-power. It has paid nothing to the state for its privileges. A list of the more important industries which this company supplies with electricity is given in Appendix B. Its managers estimate that the power plant and the industries dependent upon it for power represent an investment of \$10,000,000.

9. *II. Niagara Falls Power Company.*—In 1886 the New York legislature granted a charter to a company called the 'Niagara River Hydraulic Tunnel Power and Sewer Company of Niagara Falls,' subsequently amended in 1886, 1889, 1891, 1892 and 1893. (See chapter 83, 1886; chapter 489, 1886; chapter 109, 1889; chapter 253, 1891; chapter 513, 1892; chapter 477, 1893.) In 1889 the name of the company was changed to 'The Niagara Falls Power Company.' It is authorized to take water sufficient to generate 200,000 horse-power, computed to be about 17,200 cubic feet per second. Its franchise is for fifty years from March 31, 1886. The location of its works is shown upon the map. Beginning about a mile above the falls a short intake canal is constructed nearly at right angles with the river shore. Upon each side of the canal deep pits are excavated in the rock, at the bottom of which are placed the turbines, and over which

* Not published with this report.

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are placed the power-houses. The water, after passing through the turbines, is carried off by a tunnel about 21 feet in diameter under the city of Niagara Falls to the lower river, a distance of about 7,000 feet. The company has in operation two power-houses having a combined capacity of about 105,000 horse-power.

It is working the plant nearly to its full present capacity, using about 8,000 cubic feet per second, in addition to which one of its tenant companies is using about 600 cubic feet. It paid nothing to the state for its privileges, but is bound to furnish free of charge electricity for light and for power and also water for the use of the state in the state reservation at Niagara and the buildings thereon, when requested to do so by the commissioners of the state reservation. It distributes electric power over a wide area of territory and to a great variety of commercial interests in Niagara Falls, Tonawanda, Olcott, and Buffalo, in some cases over 35 miles distant. A list of the consumers dependent upon this company is given in Appendix C. The investment is stated by the managers to be over \$6,000,000 in the power plant, and \$7,000,000 or \$8,000,000 in other industries established on its lands at Niagara Falls and dependent upon it.

10. *III. Canadian Niagara Power Company.*—This company is an allied company of the Niagara Falls Power Company just described. It was incorporated by an Act of the legislature of the province of Ontario in 1892, which also confirmed an agreement dated April 7, 1892, between the company and the commissioners for the Queen Victoria Niagara Falls Park. In 1899 an Act was passed conferring upon those commissioners authority to modify this agreement and to make other agreements for the construction of power works, as specified above. The agreement was modified July 15, 1899, and June 19, 1901.

11. The company is authorized to construct certain works, which works will have a capacity of 110,000 horse-power, and by inference to take the quantity of water required for that purpose, although the agreement does not in terms limit the capacity of the works or the quantity of water. The amount required to supply the works which have been approved and are under construction is computed to be about 9,500 cubic feet per second. The location of the works is shown upon the map. They are of the same general type as those of its allied company on the American side. Water is taken from the river about a quarter of a mile above the falls through a short canal and fore bay and discharged through penstocks into turbines near the bottom of a deep wheel pit excavated in the solid rock, over which is placed the power-house. After passing through the turbines, the water is carried off by a tunnel about 2,000 feet long, and discharged into the river below the falls. The works are not completed, and less than half of the generators have been installed, the quantity of water used thus far being about 2,600 cubic feet per second. They are operated in connection with those of the allied company on the American side. They represent an investment of several million dollars.

12. The company agrees to pay for its privileges an annual rental of \$15,000, for which it may generate 10,000 electrical horse-power or less ; for all above 10,000 and under 20,000 horse-power it pays in addition to the above \$1 per annum for each horse-power ; for all above 20,000 and under 30,000 it pays a further sum of 75 cents per annum for each horse-power ; and for all above 30,000 it pays a still further sum of 50 cents per annum for each horse-power ; that is to say, the annual rental for generating 30,000 horse-power will be \$32,500, and for generating 110,000 horse-power will be \$72,500.

13. The period for which the privileges are granted is fifty years from May 1, 1899, but the company is entitled, at its option, to three renewals of twenty years each, the rentals to be adjusted at the time of each renewal, if the lieutenant-governor in council so desires, and at the end of the third renewal the lieutenant-governor in council may require a still further renewal of twenty years ; the entire period thus covered by the agreement being one hundred and thirty years.

14. *IV. Ontario Power Company.*—This company was incorporated by an Act of the Dominion Parliament in 1887, and was empowered to take water from the Welland

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river, or Chippewa creek, near its mouth at Chippewa—that is, indirectly from the Niagara river. On the 11th of April, 1900, it entered into an agreement with the park commissioners to construct works for that purpose, but before progressing far in the work of construction it changed its plans, and on the 28th of June, 1902, it made another agreement with the commissioners, under which it is now working. It claims that the first agreement is still valid and may be utilized hereafter if the company so desires. Under the agreement of June 28, 1902, the company is authorized to construct works according to certain plans submitted, which works will have a capacity of 180,000 horse-power, and by inference to take the quantity of water required for that purpose, although the agreement does not in terms limit the capacity of the works or the quantity of water. The amount required to supply the works, which have been approved and are under construction, is computed to be about 12,000 cubic feet per second. The location of the works is shown upon the map. Water is taken from the river at Dufferin Island, about half a mile above the intake of the Canadian Niagara Power Company, or three-quarters of a mile above the falls, and after passing through an elaborate system of screens enters a gatchouse, and thence is transmitted through three underground conduits, each 18 feet in diameter, to a power-house located near the foot of the cliff below the falls. The length of the pipe line to the nearest penstock is 6,180 feet, and to the most distant penstock about 1,000 feet more. The works, which represent an investment of several million dollars, are not completed, only about 2,000 cubic feet per second now being used.

15. The company agrees to pay for its privilege an annual rental of \$30,000, for which it may generate 20,000 electrical horse-power or less. For all above 20,000 and under 30,000 horse-power it pays, in addition to the above, \$1 per annum for each horse-power; for all above 30,000 and under 40,000 it pays a further sum of 75 cents per annum for each horse-power, and for all above 40,000 it pays a still further sum of 50 cents per annum for each horse-power; that is to say, the annual rental for generating 40,000 horse-power will be \$47,500, and for generating 180,000 horse-power will be \$117,500.

16. The period for which the privilege is granted is fifty years from April 1, 1900, but the company is entitled, at its option, to three renewals of twenty years each, and after the third renewal the lieutenant-governor in council may require a fourth renewal of twenty years, the rentals to be adjusted at each renewal, the entire period thus covered by the agreement being 130 years.

17. *V. Electrical Development Company.*—On the 29th January, 1903, the commissioners for the Queen Victoria Niagara Falls Park entered into an agreement with three citizens of Canada, subsequently transferred to 'The Electrical Development Company of Ontario (Limited),' incorporated by Act of the legislature of Ontario. (5 Edward VII., chap. 12.) Under this agreement authority was given to take from the Niagara river, water sufficient to develop 125,000 electrical horse-power. The amount is computed to be 11,200 cubic feet per second. The location of the works is shown upon the map. Water is taken from the river about midway between the intakes of the Canadian Niagara Power Company and of the Ontario Power Company, or about half a mile above the falls. A gathering dam, about 750 feet long, extends out into the river obliquely upstream, designed to divert the required amount of water into the power-house, which is located upon the original shore line. Under the power-house is a wheel pit, excavated in the solid rock to a depth of 158 feet, at the bottom of which are placed the turbines. After passing through the turbines the water is conveyed by a tunnel to the base of the falls and discharged about midway between the Canadian and American shores. The works are not completed, and no water is now being used. They represent an investment of several million dollars.

18. The company agrees to pay for its privileges an annual rental of \$15,000, for which sum it may generate 10,000 electrical horse-power or less; for all above 10,000 and less than 20,000 horse-power it pays, in addition to the above, \$1 per annum for each horse-power; for all above 20,000 and less than 30,000 it pays a fur-

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ther sum of 75 cents per annum for each horse-power; and for all above 30,000 it pays a still further sum of 50 cents per annum for each horse-power; that is to say, the annual rental for generating 30,000 horse-power will be \$32,500, and for generating 125,000 horse-power will be \$80,000.

19. The period for which the privilege is granted is fifty years from February 1, 1903, but the same provisions are made for renewals as in the cases of the other companies, and the entire period covered by the agreement is thus one hundred and thirty years.

20. In the case of each of the Canadian companies the authorities reserve the right to require that one-half the power generated shall be supplied to places in Canada.

21. Water is diverted also by the Park Electric Railway, under authority of the commissioners, the quantity to be used under plans now in execution being estimated at 1,500 cubic feet per second, developing about 8,000 horse-power, while the actual present use is about 600 cubic feet per second.

22. In addition to the foregoing, six charters were granted by the New York legislature between the years 1886 and 1894 to corporations organized to take water from the Niagara river, but it is believed that all, with the possible exception of two, have expired by limitation. In one case, the Niagara, Lockport and Ontario Power Company, an Act to renew passed the legislature in 1904, but was vetoed by Governor Odell in his message of May 14 of that year. The company, however, claims the rights granted under its original charter, and is constructing works for the distribution of electrical energy developed by other companies, but is not itself diverting water. Another corporation, the Niagara County Irrigation and Water Supply Company, has done some work, and claims that its charter has thus been preserved, but it has diverted no water. A list of these charters is given in Appendix D.

23. The Dominion of Canada has granted charters to two corporations in addition to those already mentioned, organized to take water from the Niagara river for power purposes. It has chartered two other corporations, organized to take for power purposes water from Lake Erie, which would naturally be tributary to the Niagara river. These companies have not finally developed their plants, and it is believed that their franchises are therefore not perfected, although all but one are still in force. In one case the charter has expired by limitation. The charters fix no limit to the amount of water which may be used. A charter was granted in 1889 by the province of Ontario to the Hamilton Cataract, Power, Light and Traction Company. This company is using water from the Lake Erie level of the Welland Canal, which water would otherwise be tributary to the Niagara river. The volume now being used is estimated at about 1,800 cubic feet per second, and is to be increased. A list of these charters will be found in Appendix E.

24. The Chicago Drainage Canal, constructed under the authority of the State of Illinois, was designed to divert about 10,000 cubic feet per second of water which would naturally flow over Niagara Falls. It has not been fully completed, but it now has a capacity of about 5,000 cubic feet per second. The amount which it is actually diverting has thus far been limited by the Secretary of War to about 4,200 cubic feet per second. In addition to the foregoing, about 333 cubic feet per second of Lake Erie water is now taken for power purposes from the Erie Canal at Lockport.

25. Full and precise information concerning the plans and the legal rights of the companies which have not begun or completed their works has not been obtainable. In the cases of the corporations now furnishing or preparing to furnish electricity for commercial purposes, the franchises are vague as to the volume of water to be used, which is the feature of greatest interest here. We have computed the volumes from the available data, and have endeavoured to make the figures conservative. It must be understood that these figures are fair approximations. In proceeding to an examination of the effect upon Niagara Falls of the works proposed, the subject is much simplified by considering only those companies which derive their water from the

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Niagara river itself, and that is the course here pursued. Any effects caused by these works will be exaggerated by the other works mentioned.

26. The total quantity of water to be taken from the river by works now authorized is :

	Cubic feet.
Niagara Falls Hydraulic Power and Manufacturing Company	9,500
Niagara Falls Power Company... .. .	17,200
Canadian Niagara Power Company... .. .	9,500
Ontario Power Company, not including Welland River Development... .. .	12,000
Electrical Development Company... .. .	11,200
Niagara Falls Park Railway Company... .. .	1,500
Total... .. .	60,900

Of this amount 26,700 cubic feet is to be taken on the American side and the remainder, 34,200 cubic feet, on the Canadian side. That is, 27 per cent of the average discharge and 33 per cent of the low-water discharge of the Niagara river will cease to pass over the falls when these works are completed and in full operation. The quantity to be diverted is more than double the quantity which now passes over the American falls, which at the average stage is about 27,800 cubic feet. That this will in general have an injurious effect upon the falls seems self-evident. The volume of water to be diverted is about the equivalent of the entire discharge of Lake Superior over the Sault Ste. Marie. The amount thus far actually diverted is but 17,800 cubic feet per second, and has had an appreciable effect upon the falls. To foretell with accuracy the effects in detail of the full diversion authorized would require a more complete knowledge of the bed of the river than is now obtainable. The water taken on the Canadian side below the crest of the rapids will affect the Horseshoe Fall alone. If all that taken on the American side should affect the American Fall alone, it would practically leave it dry ; but it seems probable that only a part of this diversion will be at the expense of the American Fall.

Exactly what portion that will be can not be stated with precision, but from a study of the channels and reefs, so far as they are known, a reasonable estimate is that the water would come from the two arms in about the proportion of one-sixth from the American Fall and five-sixths from the Horseshoe Fall. Exactly what form the changes in the two cataracts will take, whether they will be made narrower, or be broken up into a greater number of streams, or simply be reduced in volume, retaining in general their present form, can not now be foretold, for the reason that there is no accurate knowledge of the form of and depth of water on the crests. If 60,900 cubic feet per second be diverted, the loss will be important, but if the diversion be limited to this amount, or reduced, as hereafter indicated, it may not prove disastrous. This can not be definitely determined until the works now under construction have been completed and put in operation. When that happens, if it be found that the falls have not suffered serious damage, as a scenic spectacle, it does not follow that additional water may be diverted with impunity. Additional diversion would be an experiment even more dangerous than that now being tried, and in our opinion should not be permitted.

27. In return for the impairment of the falls thus far authorized the state of New York will receive practically nothing for the 342,000 horse-power authorized on that side, and the Queen Victoria Niagara Falls Park will receive an annual rental of \$270,000, or an average of 65 cents per horse-power for the 415,000 horse-power authorized on the Canadian side. These figures do not include the 8,000 horse-power being developed by the electrical railway nor the power developed by the Hamilton Company with water from the Welland Canal.

28. If all the water and all the head from the top of the upper rapids to the foot of the falls could be utilized, there would result over 4,000,000 mechanical horse-power. Probably space could be found, if desired, for works which would utilize about half

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of this, or, say, 2,000,000 horse-power, or possibly more. As they could not utilize all the head, they would use much more than half the water. It will require time to create a market for all this power, but it is reasonably certain that it will in due season be found if the development of the power itself is to go on unchecked. The difference in cost in favour of falling water over any other method of developing power is so great that all other methods are sure to be abandoned where sufficient water power is available. The difference at Niagara Falls is probably not less than \$15 or \$20 per annum per horse-power. The cost of transmission to distant points increases with the distance, and finally becomes so great as to be unprofitable ; but electrical engineers are engaged in improving the methods and reducing the cost. An average difference of cost for each horse-power can not now be given with any close degree of approximation, but the difference, whatever it is, is a perpetual annual saving, which, if capitalized, will show that the commercial value of the power at Niagara Falls is very great and is to be measured by the hundred millions of dollars.

29. Whether this commercial asset shall be utilized to such an extent as to seriously impair the majesty and scenic beauty of the falls depends upon the public will. In our opinion the commercial advantages of a large increase in development of power will not compensate for the great loss to the world, of the inspiration, æsthetic education, and opportunity for recreation and elevating pleasure which the mighty cataract affords. The direct advantages to the public from revenue is nothing on the New York side of the river, and comparatively slight on the Canadian side. There is of course an indirect advantage due to added taxable wealth and reduction in the cost of power, but these advantages are, in our opinion, slight in comparison with those which spring from the preservation of the beauty and majesty of the falls in their natural condition. Over 800,000 people visit the falls annually, deriving pleasure and inspiration from them. The nations of the world have always recognized the great value of parks and reservations, and throughout the civilized world they have preserved places of natural grandeur and beauty and furnished parks, artificially beautified, for rest, education and the elevation of their people. An illustration may be given in the case of the city of New York, one of many hundreds. There the municipality has acquired, in Central Park, property which is estimated to be worth \$225,000,000, and has spent millions upon its improvement and ornamentation. The United States government has reserved lands of striking picturesqueness, grandeur and interest, regardless of their value. These illustrations would seem to prove conclusively that the people are not inclined to offset mere commercial values against the intangible but none the less great advantages found in the preservation of the great works of nature.

30. It is probably not expedient to attempt the recovery of the rights granted to companies which have taken full advantage of them. In the case of the Niagara Falls Power Company, on the American side, the franchises authorize it to develop 200,000 horse-power. It has constructed works having about half that capacity, but has not begun the construction of the additional works, and we believe has no present intention of doing so. In the case of the Ontario Power Company on the Canadian side, the construction of works under the agreement of April 11, 1900, has been indefinitely postponed. The authority for the additional works in both these cases could probably be withdrawn without inflicting an unreasonable hardship. All franchises of which advantage has not been taken should be extinguished.

31. The following is a summary of the foregoing statement of facts:—

(a) The glory of Niagara Falls lies in the volume of its water rather than in its height, or in the surrounding scenery.

(b) Works are now authorized and partially completed at the falls which will divert from the Niagara River above the falls about 27 per cent of the average discharge, and about 33 per cent of the low-water discharge, which is more than double the quantity now flowing over the American Fall. In addition to this, water naturally tributary to the Niagara river is being diverted through the Chicago drainage canal, and for power in addition to navigation purposes through the Erie and the Welland canals.

(c) The effect of this withdrawal of water is to injure both the American and the Horseshoe falls in nearly equal proportions. While the injury will be perceptible, it may not be destructive or disastrous.

(d) Improvements in the transmission of electric power and increased demand will make a market for all the power which can be developed at Niagara Falls, and will cause a destruction of the falls as a scenic spectacle if the development be allowed to go on unchecked.

(e) Charters have been granted to corporations which propose to divert additional amounts in quantities not now limited.

(f) The sums of money invested, or being invested, in the works now in operation or under construction, and in the industries dependent upon them, amount to many millions of dollars. It is probably not expedient to attempt the withdrawal of the rights thus utilized.

(g) The commercial value of the water power at Niagara Falls is very great, but if compared with values set aside by wealthy communities elsewhere for park purposes this value is not too great to be devoted to similar purposes. The place is visited annually by about 800,000 people.

32. If the falls are to be preserved it must be by mutual agreement between the two countries. As a step in that direction we recommend that legislation be enacted which shall contain the following provisions, viz:—

(a) The Secretary of War to be authorized to grant permits for the diversion of 28,500 cubic feet per second, and no more, from the waters naturally tributary to Niagara Falls, distributed as follows :

	Cubic feet.
Niagara Falls Hydraulic Power and Manufacturing Co....	9,500
Niagara Falls Power Company..	8,600
Erie Canal or its tenants (in addition to lock service) .. .	400
Chicago drainage canal....	10,000

(b) All other diversion of water which is naturally tributary to Niagara Falls to be prohibited, except such as may be required for domestic use or for the service of locks in navigation canals.

(c) Suitable penalties for violation of the law to be prescribed.

(d) The foregoing prohibition to remain in force two years, and then to become the permanent law of the land, if, in the meantime, the Canadian government shall have enacted legislation prohibiting the diversion of water which is naturally tributary to Niagara Falls, in excess of 36,000 cubic feet per second, not including the amounts required for domestic use or for the service of locks in navigation canals. It is assumed, however, that an understanding upon this subject would be reached by treaty.

33. The object of such legislation would be to put a stop to the further depletion of the falls, and at the same time inflict the least possible injury upon the important interests now dependent upon this water power. The amount to be diverted on the Canadian side has been fixed with a view to allowing to the companies on that side the amounts for which they now have works under construction, which are:

	Cubic feet.
Canadian Niagara Power Company	9,500
Ontario Power Company..	12,000
Electrical Development Company	11,200
Niagara Falls Park Railway Company	1,500
Welland Canal or its tenants (in addition to lock service) ..	1,800

34. One of the effects of such legislation would be to give to Canada the advantage of diverting 7,500 cubic feet per second more than is diverted in the United States. The advantage is more apparent than real, since the power generated on the

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Canadian side will to a large extent be transmitted to and used in the United States. In the negotiation of a treaty, however, the point should be considered.

35. The substance of this report was submitted to our Canadian colleagues before the passage of the joint resolution, with a view to uniting in a joint report under the general law providing for the commission. There was a substantial agreement in the statement of facts, and such differences as developed with respect to the recommendations which ought to be made did not seem unsuperable, but our colleagues desired time for further consideration. We have no doubt of their sympathetic interest in carrying out that part of the instructions contained in the resolution which requires us 'to exert in conjunction with the members of said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of Niagara Falls in their natural condition.'

Very respectfully,

O. H. ERNST,
Colonel, Corps of Engineers, Chairman.

GEORGE CLINTON,
Member.

GEO. Y. WISNER,
Member, American Section.

THE SECRETARY OF WAR,
Washington, D.C.

APPENDIX A.

STATE OF NEW YORK,
ATTORNEY-GENERAL'S OFFICE,
ALBANY, November 16, 1895.

DEAR SIR,—Some time ago the question of the right of the Niagara Falls Hydraulic Power and Manufacturing Company to enlarge the capacity of their canal, by which a portion of the water of the Niagara river is diverted for manufacturing purposes, was submitted to me for examination by you. The question is one involving great interest, not only to the corporation referred to, but to the state itself, and I have therefore considered it with a great deal of care before venturing to express an opinion.

The facts in the case may be briefly stated. The canal in question was originally constructed in the year 1859. Its dimensions were 70 feet wide by 14 feet deep. The inlet is at Port Day, about 1 mile above the falls, and it runs through a strip of land 100 feet wide to the mills on the bank of the river below the falls, where the waters, after supplying power to various industries, are discharged into the river.

About the year 1878 the title to the land in the 100-foot strip, as I am informed by Mr. Schoelkopf, of Niagara Falls, was acquired by the present owners, since which time the canal has been in active operation, and has supplied power to mills of a sufficient capacity to employ a large number of hands, residents of the city of Niagara Falls, and whose continued prosperity, to a very large degree, is dependent upon the operation of the mills in which they are employed. Sometime after the acquisition of title to the strip of land by the present owners they made application to the land commissioners of the State of New York for a grant of land under water adjoining the inlet to the canal.

In the papers submitted on that application it was stated to be the intention of the owners to increase the capacity of the canal, and thereby increase its production of horse-power. The grant was made by the commissioners with the condition that no

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structures were to be built upon the granted land without the consent of the Niagara Reservation Commission. Thereafter application was made to the reservation commission for leave to erect cribs on the land under water, the purpose of which was to prevent the flow of ice and other refuse into the canal, to the detriment of the interests of the Niagara Falls Hydraulic Power and Manufacturing Company.

The capacity of the canal at that time, if I am correctly informed, was 200,000 cubic feet per minute. No objection was made (at least publicly) to this diversion of the waters of the river at that time. Since then, however, various grants of privileges by the legislature of the State have been given to several corporations to divert the waters of the Niagara River for power purposes. In consequence of these grants apprehension has been created as to the probable effect upon the flow of water over the falls, and your commission, actuated by commendable zeal to protect the great natural beauty of the reservation, have determined that further encroachments upon the stream shall be prevented, if possible.

The law under which your board was created (chap. 336, Laws of 1883) states that the object of the creation of the commission was to preserve the scenery of the Falls of Niagara. It provides for the condemnation of the lands to be selected by the commission, and for the compensation to be paid to the owners of the property condemned. In carrying out the provisions of the law several million dollars have been expended by the State of New York, which will be converted into a mere waste of public moneys if the flow of water over these falls is to be seriously diminished.

While this is, of course, a very serious consideration, I have not permitted myself to lose sight of the importance to the industries dependent upon the maintenance of the canal for their power, which action on the part of the State authorities will have.

It is a very grave duty to be compelled to pass upon public questions wherein such great private interests are concerned. Nevertheless it is one which I see no way to escape, and while from certain considerations I would be pleased to arrive at a different conclusion, I am compelled to hold, from my examination of the law on the subject, that the Niagara Falls Hydraulic Power and Manufacturing Company may be restrained from increasing the capacity of the canal. It is only fair, however, that my reasons for this conclusion should be stated. They are as follows:—

The Niagara river is a public navigable stream, to the bed of which, and the water flowing over it, the State and not the riparian owner has title.

It would be a waste of time to attempt to show why this proposition is correct. It is sufficient to say that it has been amply supported by judicial decisions and is now the established law.

Ill. C.R.R. Co. v. Ill. (146 U.S., 387).

Smith v. Rochester (92 N.Y., 479).

Matter of St. Reservation (16 Abb. N.C., 395).

The sole question, therefore, for determination is, 'Can an owner of the soil adjoining a navigable stream divert the water for private manufacturing purposes without the consent of the State?' Let us examine it.

By the term 'navigable,' it must be remembered, is not meant 'capable of being navigated.' As used in this discussion, 'navigable stream' means one which is navigable in the legal sense. Rivers may be navigable in fact but not in law, or they may be navigable in law but only in part navigable in fact. A mere local interruption of actual navigability, therefore, will not change the character of a stream in its legal aspect.

The river being navigable, in the legal sense, the title to the bed of the stream and to the water flowing over it is in the State, at least to the boundary line between the State and Canada.

People v. Appraisers (33 N.Y., 464).

Crill v. Rome (47 How. Pr., 398).

Morgan v. King (35 N.Y., 454).

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People *v.* Tibbetts (19 N.Y., 523).

Ex parte Jennings (6 Cow., 518).

Therefore, leaving out of view for the present the grant of land under water to the Hydraulic Power and Manufacturing Company, the State could unquestionably deprive the corporation of all use of the waters of the river for power purposes by devoting the stream to other public use.

Smith *v.* Rochester (92 N.Y.).

Whether or not that has been done by the laws establishing the Niagara reservation I will discuss hereafter. I prefer at this point to consider the abstract question of the right of an owner of land adjoining a navigable stream to divert a considerable portion of the waters for manufacturing purposes without a grant or prescriptive right.

Nuisances may always be abated by action in the name of the aggrieved party. Public nuisances include any encroachment upon highways or navigable streams, and it is not an essential characteristic of the encroachment upon the stream that it should be an actual hindrance to navigation.

Wood on Nuisances, 2d ed., secs. 478-480, and cases cited.

The diversion of water from a public stream for any other than domestic purposes is a nuisance, and therefore may be abated at the suit of the Attorney-General.

Philadelphia *v.* Gelmartin (71 Penn. St., 140).

The Niagara Falls Hydraulic Power and Manufacturing Company is organized under the Act of 1875, chapter 611. Its objects are declared to be the development of the hydraulic canal in Niagara Falls, and the establishment and conducting of various manufacturing interests. Under its charter it is not only supplying its own mills but is furnishing other industries with power for a consideration. So far as the latter fact is concerned, certainly no question can be raised as to the rights of a riparian owner to the use of water for his own benefit. I assume the fact that the capacity of the canal at the outset was sufficient for all the purposes of the power company, and that the increased capacity is desired for the purpose of enabling the corporation to derive a revenue from its sale of power to others. I have no hesitation in declaring this to be unlawful. A non-riparian owner is not entitled to any benefits of a stream other than those enjoyed in common by the public, and a riparian owner at the most is entitled only to personal benefits derivable from use devoted to personal purposes solely. They do not include the transmission of power to property located upon premises that may be far removed from the lands of the riparian owner.

The case last cited was an action brought by the owner of a boat which had been prevented from navigating the Schuylkill, by reason of the diversion of the waters of that stream by the city of Philadelphia for domestic or other purposes. The court in its opinion says:

‘In deciding upon the question of illegality in drawing off the water from the navigation, we are carried beyond its use for power, to inquire into the character of the consumption claimed as an overruling necessity. We have already seen that the city is a large vendor of water from which she is deriving revenue, for all the purposes of the arts, manufacturing, business and pleasure. These uses are not domestic, that is, such as are for the preservation of the life and health of the population and their creatures, but are simply utilitarian or business uses, and far exceed those needed for domestic purposes. And even as to those termed domestic, a distinction must be noted between the use proper and that which is lavishly expended in pavement washing, baths, &c. It is perfectly obvious, therefore, that the city drew off water not only for driving and lifting power, but for a consumption far beyond any imperious necessity, and for purposes wholly subordinate to the right of navigation. She chose to prefer the pecuniary interests of her citizens, and doing an injury thereby she must make compensation to the injured parties. I mean not by these remarks to draw any comparison between the importance of the use of the water for the

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great purposes of industry, wealth, and cleanliness of a city so populous as Philadelphia, and the use of it for navigation during a few days of drought. The question for us is that of legal right, not comparative weight. Such important interests as those of the city are not likely to lead to the substitution of might for right; yet, they are not of that imperious necessity which justifies might, and changes wrong into right. Administrators of the law, we cannot bend or break the law before a large interest, more than we can before one that is small. The doctrine of imperious necessity is not in this case.'

It is historical that the Niagara river at Fort Day has been navigated by vessels of large burden, and, indeed, to a point some distance below. The erection of cribs to divert ice and other refuse from the canal inlet is, therefore, an actual obstruction to navigation, and it is not necessary to show present use of the river at this point for navigation purposes. Once a highway, always a highway, is true of navigable streams. (*See Yolo v. Sacramento*, 38 Cal., 193; *Wood on Nuisances*, 478, 485.)

Ex parte Jenkins (6 Cowen, 518) is also of interest on this point. That was a proceeding brought in mandamus to compel commissioners appointed to appraise damages occasioned by the diversion of the stream of the Chittenango for the purposes of the Erie Canal, which diversion prevented the use of the water of the stream by riparian owners for power purposes in operating mills. The court in awarding mandamus, says:—

'The objection is contained in the affidavits of Mr. Seymour that, in point of fact, the State has not parted with the land upon which the Chittenango passes, at the places claimed, but had bounded purchases of land on the margin of the stream, so that, as he believes (and he believes the other appraisers were satisfied of the fact being so), the State was still the owner of the land covered by the waters of the stream, and had not parted with it or contracted to part with it, to any person whatever, or authorized the use of the water for hydraulic purposes at the places in question. If the construction set up by the commissioners be the true one, if the State owns the land covered by the water, it is clear that, though the relators may be entitled to the use of the water flowing by and touching upon them for all ordinary purposes, yet they cannot build mills upon and raise the water of the stream. They are trespassers, and the State may claim not only the waters, but the mills themselves, so far as they encroach upon the stream.'

I will not consider the effect of the grant by the land commissioners of lands under water to the corporation operating the canal.

The powers of the land commissioners at the time the grant was made were conferred by section 67, page 633, volume 1, eighth edition, Revised Statutes. It reads:

'The commissioners of the land office shall have power to grant, in perpetuity or otherwise, so much of the lands under the waters of navigable rivers or lakes as they shall deem necessary to promote the commerce of this State, or proper for the purpose of beneficial enjoyment of the same by the adjacent owner.'

The court of appeals, in passing upon the character of such grant, says: 'In every such grant there was an implied reservation of the public right, and so far as it is assumed to interfere with it, or to confer the right to impede or obstruct navigation, or to make an exclusive appropriation of the use of navigable waters, the grant was void.'

Again: 'Public grants to individuals under which rights are claimed in impairment of public interests, are construed strictly against the grantee, for it is reasonable to suppose that if they were intended to have this operation, the intention would have been expressed in plain and explicit language.'

People v. N.Y. & Staten Island Ferry Co. (68 N.Y., 71).

I have been unable to find any language in the grant to the Niagara Falls Hydraulic Power and Manufacturing Company which can be construed as authorizing them to divert the waters of the Niagara river. Applying the principles in the case

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last cited, it is certain that that grant can afford no defence to an action brought to restrain the unlawful taking of the waters.

It now remains to determine whether or not the waters of the Niagara river have been devoted by the legislature to a public use to an extent that will prevent the diversion of the water above the falls for power purposes. The objects and purposes of the statutes creating the Niagara reservation were to preserve a great natural waterfall and its environments for the enjoyment of the people of this State. In fact, the statutes themselves declare that the commissioners shall take all proper steps to restore and afterwards to preserve the scenery as nearly in its natural state as possible.

The flow of water over the falls is an essential element in the preservation of the scenery, and if it can be shown (as I am informed it can) to be the fact that the diversion of the large quantities of water through the canal of the Niagara Falls Hydraulic Power and Manufacturing Company has a diminishing effect upon the flow of the water over the falls, the diversion is a nuisance and can be restrained.

All of which is respectfully submitted.

T. E. HANCOCK,
Attorney-General.

HON. ANDREW H. GREEN,
President Niagara Reservation Commission, New York city.

APPENDIX B.

LIST OF DEPENDENT INDUSTRIES OF THE NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING COMPANY.

Electric light for street and store service.
Pittsburg Reduction Company.
Niagara Falls Brewing Company.
Wm. A. Rogers (Limited.)
Niagara Gorge Railroad.
Youngstown and Lewiston Railroad.
National Electrolytic Company.
Acker Process Company.
Walker Manufacturing Company.

Cliff Paper Company.
Cataract City Milling Company
Pettebone-Cataract Paper Company.
Oneida Community Company.
City Waterworks.
Niagara Falls Milling Company.
Carter Crum Company.
Central Machine Company.

APPENDIX C.

The Niagara Falls Power Company—List of users.

	Maximum power.	Transmis- sion dis- tance.
	Horse-power.	Miles.
NIAGARA FALLS, N.Y.		
The Pittsburg Reduction Co.....	8,000	0.46
The Carborundum Co.....	5,000	.38
Union Carbide Co.....	17,000	2.00
Niagara Electro-Chemical Co ..	3,000	.75
Niagara Falls Lighting Co....	1,000	.14
International Railway Co.....	1,500	.....
The Niagara Falls Water Works Co. (hydraulic power).....	300	.....
International Paper Co. (hydraulic power)....	8,000	.....
Castner Electrolytic Alkali Co.....	8,500	.85
Cldbury Electro-Chemical Co.....	2,500	2.18
International Acheson Graphite Co.....	2,000	.28
Acetyvone Manufacturing Co.....	50	.95
Roberts Chemical Co.....	500	1.90
Francis Hook and Eye and Fastener Co.....	15	.47
Norton Emery Wheel Co.	1,500	.95
The Natural Food Co.....	1,500	.66
Ramapo Iron Works.....	500	1.70
By-Products Paper Co.....	500	.19
Composite Board Co.	200	.34
Niagara Research Laboratories ..	500	.28
Lockport Paper Co.....	500	.....
Cataract Consumers Brewery.....	140	.....
Development and Funding Co.	750	.....
Niagara Tachometer and Instrument Co.....	15	.....
Ozone Vanillin Co.....	125	.....
Phosphorus Compounds Co.....	50	.....
Acheson Siloxicon Articles Co ..	50	.....
Niagara River Manufacturing Co.....	800	.....
NIAGARA FALLS, ONTARIO.		
A. C. Douglass, contractor.....	400	3.00
Niagara, St. Catharines and Toronto Railway ..	500	3.80
Lighting Co.....	500	3.40
Canadian Shredded Wheat Co. (Limited)....	75	.....
International Acheson Graphite Co.....	200	.....
Larkin, Sangster and Marshall, contractors.....	2	.....
Loretto Convent.....	40	.....
Monastery of Mount Carmel.	35	.....
TONAWANDA.		
International Railway Co	1,500	.....
Tonawanda Board and Paper Co.....	1,200	15.00
Buffalo Bolt Co ..	160	14.00
Philip Houck Milling Co.....	142	14.00
F. J. Alliger Co.....	107	15.00
Adamite Abrasive Co	50	14.50
Orient Manufacturing Co	20	14.00
Felton School.....	22	14.00
LOCKPORT.		
International Railway Co....	1,000	26.00
OLCOTT.		
International Railway Co..	1,000	39.00
BUFFALO.		
Buffalo General Electric Co	6,000	27.60
Great Northern Elevator.....	900	29.50
Electric Grain Elevator.	200	30.70
Buffalo Elevating Co.....	950	29.00

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The Niagara Falls Power Company—List of users—Continued.

	Maximum power.	Transmis- sion dis- tance.
BUFFALO—Continued.	Horse-power.	Miles.
Buffalo Cereal Co.....	375	30.30
American Brake Shoe and Foundry Co.....	40	33.20
Charles G. Curtiss Co.....	125	25.50
McKinnon Dash Co.....	100	24.40
The Gypsum Products Co.....		
The General Railway Signal Co.....		
Schoellkopf & Co.....	50	30.00
The National Battery Co.....	90	26.30
International Railway Co.....		
Great Eastern Elevator.....	900	30.00
Buffalo Dry Dock Co.....	133	30.00
Edward Elsworth & Co. (H. O. Mills).....	150	30.00
Snow Steam Pump Works.....	150	33.30
The Jacob Dold Packing Co.....	100	32.50
The John Kam Malting Co.....	225	24.30
Pratt & Letchworth Co.....		
The Wood & Brooks Co.....	100	24.40
Sidney Shepard & Co.....	100	30.00
Iron Elevator and Transfer Co.....	165	30.60
W. W. Oliver Manufacturing Co.....	15	24.70
New York Car Wheel Co.....	200	24.30
The United States Rubber Reclaiming Works.....	995	31.70
The American Radiator Co. (Bond plant).....	200	24.00
Barcalo Manufacturing Co.....		
American Agricultural Chemical Co.....	125	32.00
Acme Steel and Malleable Iron Works.....	50	24.80
Cumpson-Prentiss Coffee Co.....	30	29.10
J. I. Prentiss & Co.....	30	29.00
Schoellkopf, Hartford & Hanna Co.....		
The U. S. Hame Co.....		
Knowlton Warehouse Co.....		
Iroquois Brewing Co.....		
Faxon, Williams & Faxon (bakery).....		
The Sherwood Manufacturing Co.....		
Duffy Silk Co.....		
American School Furniture Co.: Foundry.....		
Works.....		
Buffalo City Waterworks.....		
Duluth Superior Milling Co.....		
The Frontier Ice and Stone Co.....		
The New York Central and Hudson River R. R. (shops).....		
The Erie R. R. Co. (shops).....		
The General Chemical Co.....		
The Oswegatchie Manufacturing Co.....		
G. F. Zeller & Sons.....		
Buffalo Foundry Co.....	240	35.10
H. O. Mills Annex.....	255	29.30
The Jewett Refrigerator Co.....	30	24.80
Buffalo Pitts Co.: Works.....	187	35.50
Foundry.....		
Buffalo Brake Beam Co.....	30	25.00
Buffalo Dental Manufacturing Co.....	20	35.50
Keystone Manufacturing Co.....	25	24.80
R. L. Ginsburg & Sons.....	33	34.00
Buffalo Weaving and Belting Co.....	65	25.50
H. W. Dopp Co.....	10	25.00
Frontier Iron Works.....	15	25.00
The Crosby Co.....	50	33.00
Spencer Kellogg.....	500	29.20
The Lake Erie Engineering Works.....		
John Schmitz.....		
The Battle Creek Breakfast Food Co.....		
The Collins Baking Co.....	50	33.20
George Urban Milling Co.....	450	34.50
C. Kurtzmann & Co.....		

The Niagara Falls Power Company—List of users—Concluded.

	Maximum power.	Transmis- sion dis- tance.
	Horse-power.	Miles.
BUFFALO—Concluded.		
The Buffalo Gasoline Motor Co.....	20	25.00
The Niagara Mill and Elevator Co....	100	26.00
Pratt & Lambert.....	19	24.50
The Delaware, Lackawanna and Western R. R. shops.....	150	34.50
The Niagara Cordage Co.....		
The U. S. Headlight Co.....	40	26.00
H. Messersmith (Laverack Building).....	100	28.20
The Buffalo Structural Steel Co.....	30	26.00
The Wegner Machine Co.....	40	29.00
J. N. Adam & Co.....	100	28.20
The estate of Walter Cary (Genesee Hotel).....	100	28.10
The McLean Box Factory.....		
The George N. Pierce Co.....		
The American Malting Co.....		
The Buffalo Fertilizer Co.....		
The Buffalo Rubber Manufacturing Co. .		
The U. S. Cast Iron Pipe and Foundry Co.....		
The L. V. R. R. Co. shops.....		
The Buffalo Box Factory.....		
American Radiator Co. (Pierce plant).....		
Rogers Plating and Foundry Co.....		
Fleming Warehouse Co.....		
Hewitt Rubber Co.....		
C. & B. Transit Co.....		
The D. H. Stoll Co.....		
The Ontario Elevator.....		
L. M. Ericsson Telephone Manufacturing Co.....		
The Niagara Malting Co.....		
The Buffalo Union Furnace Co.....		

APPENDIX D.

Statement concerning companies incorporated to take water from Lake Erie and Niagara river, but which have not as yet constructed works under these charters.

AMERICAN SIDE.

Lockport Water Supply Company.—Incorporated 1886. New York State. Empowered to supply water for manufacturing and other purposes to cities within the county of Niagara; to take water from the Niagara river between the mouth of Tonawanda creek and the east line of lot No. 52 of the Mile reserve, and to discharge water into Lake Ontario or into Eighteen Mile creek. Work to be commenced by 1891. No work done.

Lewiston Water Supply Company.—Incorporated 1888. New York State. Empowered to supply water to Lewiston and other towns in the township of Niagara and Lewiston for manufacturing or other purposes; to take water from the Niagara river between Cayuga creek and the east line of lot 46, Mile Reserve; discharge water into Niagara river near the town of Lewiston. Work to be commenced by 1893. No work done.

Buffalo and Niagara Power and Drainage Company.—Incorporated 1889. New York State. Empowered to build and operate public raceway in connection with the Niagara river for water power and other purposes; to take water from and discharge

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water into the Niagara river at such points as may be convenient. Work to be completed by 1894. No work done.

Niagara County Irrigation and Water Supply Company.—Incorporated 1891. New York State. Empowered to build and operate public waterway from Niagara river between Cayuga creek and lot 71 of Mile Reserve; to supply water to Lewiston and other villages in the townships of Niagara, Lewiston and Porter; to lease and sell water for manufacturing and other purposes; to take water from Niagara river between points specified and discharge into Niagara river near Lewiston or Porter. Work to be commenced by 1896. This company claims to have done some work, and to be proceeding with development.

Niagara Power and Development Company, originally the Model Town Company.—Incorporated 1893. New York State. Further legislation 1894. Authorized to build a town and equip plants for all public utilities therein. Empowered to take water from Lake Erie or Niagara river for all purposes except for motive power for factories. May purchase or lease franchise of the Niagara County Irrigation and Water Supply Company.

Niagara, Lockport and Ontario Power Company.—Incorporated 1894. Empowered to supply water and electricity to Lockport and other cities in Niagara, Erie, and Orleans counties; to take water from the Niagara river between mouth of Tonawanda creek and east line of lot 52 of Mile Reserve and discharge water into Lake Ontario or Eighteen Mile creek. Work to be commenced by 1904. In 1904 failed to obtain legislation to perpetuate right to take water from Niagara river. Is now building works for distribution of electric energy.

APPENDIX E.

Statement concerning companies incorporated to take water from Lake Erie and Niagara river, but which have not as yet constructed works under these charters.

CANADIAN SIDE.

Ontario Power Company, originally Canadian Power Company.—Incorporated 1887. Dominion Parliament. Other legislation 1891, 1893, and 1899. Empowered to build a canal and hydraulic tunnel from Welland river, near junction of Niagara, to Niagara river south of the whirlpool, and to supply water, electricity, or other power. As this company is empowered to make two separate developments, one of which is well under way, and as the Act of 1899 empowers it to extend and enlarge its works as demanded by business, there is apparently no limit as to the time when the second development may be commenced.

Hamilton Cataract Power, Light and Traction Company, originally Cataract Power Company of Hamilton.—Incorporated 1889. Province of Ontario. Further legislation 1904. Empowered to build and operate a canal and raceway from near Allanburg to the Welland river near Port Robinson as an extension of their canal from near Decews Falls. This company is said to lease from the Dominion government water from the Lake Erie level of the Welland canal.

Jordan Light, Heat and Power Company, originally Hamilton and Lake Erie Power Company.—Incorporated 1895. Further legislation 1898, 1903. Dominion parliament. Empowered to build and operate water course from Welland river between 12 and 30 miles from Niagara river to a point on Jordan river, and may dredge Welland and Jordan rivers; to use the waters of Lake Erie and Niagara river in such quantity as may be necessary for their purposes; to supply water and electricity or other power. To be completed by 1911.

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Erie and Ontario Power Company.—Incorporated 1903. Dominion Parliament. Authorized to build and operate water course from Grand river or Lake Erie to Jordan River and Lake Ontario; to take waters of Lake Erie and to dredge Jordan river; to supply electric or other power and convey the same. To be completed 1908.

Niagara Welland Power Company, originally Welland Power and Supply Company. Incorporated 1894. Further legislation 1891, 1899, 1903, and 1905. Dominion Parliament. Empowered to build and operate canal from Welland river near Niagara river to near Thorold and to carry off surplus water to Lake Ontario; to supply power and to use canal for navigation. To be completed by 1910.

North American Canal Company.—Incorporated 1893. Dominion Parliament. Authorized to build and operate canal from Lake Erie near Port Colborne to Lake Ontario near Port Dalhousie, or to Niagara river near Queenston; canal to be 20 feet deep and sufficient width for two of the largest vessels to pass at full speed. Authorized to maintain a current of 3 miles per hour. To sell or lease water and hydraulic or other power. May dredge in the Welland and Niagara rivers. To be completed by 1903.

DEPARTMENT OF STATE,

WASHINGTON, March 19, 1906.

THE PRESIDENT:

In reply to your letter of the 15th instant, transmitting the resolution of the Colonial Dames of America relative to the preservation of Niagara Falls, and stating your desire to be informed regarding the present status of the negotiations with Great Britain on the subject, I have the honour to inclose herewith copies of correspondence had to the present time, through the War Department, with the American section of the International Waterways Commission.

Respectfully submitted.

ELIHU ROOT.

DEPARTMENT OF STATE,

WASHINGTON, February 13, 1906.

SIR,—Several months ago the State Department and the British ambassador took up the subject of a possible treaty between the United States and Great Britain relating to the use of the waters of the Niagara river and the preservation of the falls.

On the 13th of November the ambassador transmitted to the department, a report of the Canadian Privy Council, approved November 2, 1905, which stated that a report from the Canadian section of the Waterways Commission stated that the commission was studying the subject and expected to be able to 'make a joint report to the government of the United States and to the government of Canada before long, recommending the adoption of rules and regulations which would prevent in the future the destruction of Niagara Falls by the use of its waters by manufacturers.'

In the report by the American section, made to the Secretary of War on December 1, 1905, occurs the following statement:—

'The commission has made good progress in the collection of data bearing upon some of these questions, particularly those relating to the use of water at Niagara Falls.'

On the 28th of October, 1905, the commission appears to have adopted the following resolutions:—

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Resolved, That this commission recommends to the governments of the United States and Canada that such steps as they may regard as necessary be taken to prevent any corporate rights or franchises being granted or renewed by either Federal, State, or provincial authority for the use of the waters of the Niagara river for power or other purposes until this commission is able to collect the information necessary to enable it to report fully upon the 'conditions and uses' of those waters to the respective governments of the United States and Canada.

The negotiation relating to a treaty on this subject has been suspended awaiting the further report of the commission, in accordance with the statements to which I have referred. There are many indications of active public interest in this subject, and a joint resolution having in view the preservation of the falls, pending in the House of Representatives, has been favourably reported by the committee on Rivers and Harbours. The indications are that if an agreement can be reached between the two countries as to the action necessary to accomplish the purpose, any legislation to give the agreement effect on the part of the American authorities would receive favourable consideration at the present session of congress and at the present session of the New York legislature.

It seems desirable, therefore, to press forward the negotiation for such an agreement without any avoidable delay. May I ask you to ascertain whether the joint commission is not now prepared to make such a report upon the subject as may furnish a basis upon which the State Department and the ambassador may take up and proceed with the negotiation?

I have the honour to be, sir, your obedient servant,

ELIHU ROOT.

The SECRETARY OF WAR.

WAR DEPARTMENT,

WASHINGTON, February 19, 1906.

SIR,—I have the honour to acknowledge the receipt of your letter of the 13th instant, in which you call attention to the fact that negotiations for a possible treaty between Great Britain and the United States in regard to the use of waters of Niagara river and preservation of the falls are now suspended, awaiting a further report from the International Waterways Commission is now prepared to make such report as may furnish a basis upon which the Department of State and the British ambassador may be able to proceed with the matter.

Replying thereto I beg to inform you that the chairman of the American section of the International Waterways Commission, Col. O. H. Ernst, to whom your letter was referred, reports under date of 17th instant, as follows:—

A copy of this letter has been sent to the chairman of the Canadian section and also to the other members of the American section of the International Waterways Commission in order that they may be prepared to discuss and act upon the question referred to at their next meeting.

It is expected that a meeting can be held during the week beginning February 26, when it is hoped and believed that the map of the locality which the commission has had under construction will be entirely completed.

The outcome of the meeting referred to by Colonel Ernst will be promptly communicated to the Department of State.

Very respectfully,

ROBERT SHAW OLIVER,

Acting Secretary of War.

The SECRETARY OF STATE.

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DEPARTMENT OF STATE,
WASHINGTON, March 13, 1906.

MY DEAR MR. SECRETARY,—I notice in the newspapers that the International Waterways Commission has taken some action about the Niagara Falls matter.

Have you received any report? If not, can you get one from them?

Very truly, yours,

Hon. WILLIAM H. TAFT,
Secretary of War.

ELIHU ROOT.

REPORTS ON THE EXISTING WATER-POWER SITUATION AT NIAGARA
FALLS, SO FAR AS CONCERNS THE CANADIAN POWER COMPANIES
AND THEIR ASSOCIATED TRANSMISSION COMPANIES.

REPORT BY THE AMERICAN MEMBERS OF THE INTERNATIONAL WATERWAYS COMMISSION.
INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF AMERICAN SECTION,

BUFFALO, N.Y., September 29, 1906.

MR. SECRETARY,—The American members of the International Waterways Commission have examined the report dated August 15, 1906, by Capt. Charles W. Kutz, Corps of Engineers, U. S. Army, upon the subject of permits to the power companies at Niagara Falls, referred to them by your endorsement of September 5. They have the honour to return it herewith, and to submit in connection therewith the following remarks:—

In our report* dated March 19, 1906, we stated that the works projected on the American side at Niagara Falls would produce 342,000 horse-power besides a small amount on the Erie canal, and would consume about 28,000 cubic feet of water per second, while those projected on the Canadian side would produce 432,000 horse-power besides a small amount on the Welland canal, and would consume about 36,000 cubic feet of water per second. We thought that the amount on the American side could be reduced to 242,000 horse-power, using 18,500 cubic feet of water per second, without inflicting undue hardship upon invested capital, but we doubted the expediency of attempting to withdraw the other rights acquired by the power companies at Niagara Falls. These views were adopted by Congress with qualifications.

In the Act approved June 29, 1906, the amount of water to be diverted on the American side was cut down to 15,600 cubic feet per second in the first instance, but with the provision that additional amounts may be diverted after an interval of not less than six months if it be found that that can be done without detriment to Niagara Falls or the river.

The amount of power to be generated on the Canadian side was cut down from 423,000 to 350,000 horse-power, the control of Congress in the matter arising from the fact that a very large percentage of the Canadian output must, under present conditions, find a market in the United States. Under no circumstances is the total to be increased, but the amount which may be transmitted to the United States is to be diminished as the amount consumed in Canada shall increase. In this sliding scale a limit is fixed which divides the permits into two kinds, one of which may possibly be expected to have somewhat more permanency than the other, viz., *permits* to trans-

* Printed in Senate Doc. No. 242, Fifty-ninth Congress, first session.

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mit electrical power from Canada into the United States to the aggregate amount of 160,000 horse-power, and *revocable permits* for the transmission of additional electrical power to the extent just indicated. It appears to us that this distinction was made for the purpose of giving a little more assurance of permanency to certain of the permits than it was possible to give to all of them, and not for the purpose of trying an experiment as to the effect upon the falls, of the diversion of a quantity of water so indefinite in amount. This view seems confirmed by the fact that the maximum amount allowed on the Canadian side, 350,000 horse-power, is about 83 per cent of the amount mentioned in the report, 423,000 horse-power, while the amount allowed on the American side, 15,600 cubic feet per second, is about 84 per cent of that mentioned in the report, the percentage of reduction thus being practically the same in the two cases. We see no reason why revocable permits for the transmission of power from Canada into the United States, additional to the 160,000 horse-power first to be authorized, should not be issued without delay if application for such permits be received.

The law provides for the issuance by the Secretary of War of four kinds of permits, viz. :—

1. Permits to divert water from the Niagara river on the American side to an aggregate amount not exceeding 15,600 cubic feet per second.

2. Revocable permits to divert additional water from the Niagara river on the American side to such amount, if any, as shall not injure the river as a navigable stream or as a boundary stream, and shall not injure the scenic grandeur of Niagara Falls ; but no such permits shall be issued until approximately the 15,600 cubic feet per second mentioned above shall have been diverted for a period of not less than six months.

3. Permits to transmit electrical power from Canada into the United States to the aggregate amount of 160,000 horse-power.

4. Revocable permits for the transmission of additional electrical power from Canada into the United States, but in no case shall the amount included in such permits together with the 160,000 horsepower mentioned above and the amount generated and used in Canada exceed 350,000 horse-power.

Applications have been received for permits of the first and third kinds, but in this report Captain Kutz confines himself to a consideration of those relating to the transmission of power from Canada into the United States, deferring to a future report all that concerns the diversion of water on the American side. He defers also a consideration of the question of granting transmission permits for amounts additional to the first 160,000 horse-power, expressing the opinion that it is 'the intent of the law to delay the issue of such permits until it is known what appreciable effect, if any, will be produced on the falls by the diversion of the amount of water that will be used under the first limitation.' As above stated, we do not concur in that opinion ; but the fact that no applications have been received for permits of this kind is sufficient reason for not discussing them at this time.

Applications for the transmission of power have been received from four companies, including the International Railway Company, whose rights under Canadian law to transmit power to the United States are in dispute and whose claims are small compared with those of the other companies. Captain Kutz recommends that no permits be issued to that company at this time, but that 2,500 horse-power be reserved for the present in order that it may be possible to grant the company a permit for that amount hereafter should the controversy over its rights under the Canadian laws be decided in its favour. In that recommendation we concur.

There will remain 157,500 horse-power to be divided among the three remaining applicants. These applicants are the American transmission companies, but their interests are identical with those of the Canadian companies from whom they derive power and must be considered in connection therewith. They are :

1. Niagara, Lockport and Ontario Company, taking power from the Ontario Power Company, applying for 90,000 horse-power.

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2. Electrical Transmission Company, taking power from the Electrical Development Company, applying for 62,500 horse-power.

3. Niagara Falls Power Company, taking power from the Canadian Niagara Power Company, applying for 121,500 horse-power.

The application of the Niagara Falls Power Company is for 11,500 horse-power more than the capacity of the works from which it is to derive power when completed as designed. The other companies ask for one-half the capacity of the works furnishing the power when completed as designed. The total amount asked for is 274,000 horse-power.

Captain Kutz has spared no pains in the collection of all the facts which have a bearing upon the question of how the available amount shall be divided among the three companies. After a careful consideration of the amounts of capital invested in the power plants, the amounts required to complete the works as designed, their capacity as completed under expenditures now made or pledged, their capacity as designed, the amounts of capital invested in transmission lines in the United States or on Canadian soil to connect with the United States, the contracts made for furnishing and receiving power, and other data, he concludes that there is no sufficient reason for discrimination between the companies except their relative ability to command the Canadian market. The Electrical Development Company was organized with that market prominently in view and is able to obtain a sale there of about 25,000 horse-power more than either of the other companies. Its claim to the American market is diminished by that amount. If the quantity allotted to that company be 37,500 horse-power there will remain 120,000 horse-power to be equally divided between the Ontario Power Company and the Canadian Niagara Power Company, giving them 60,000 horse-power each. We believe this to be an equitable division of the power available and we join with Captain Kutz in the recommendation that permits for the transmission of power to the United States be granted to :

	Horse-power.
The Niagara, Lockport and Ontario Company from the Ontario Power Company..	60,000
The Electrical Transmission Company from the Electrical Development Company....	37,500
The Niagara Falls Power Company from the Canadian Niagara Power Company....	60,000

Yours very respectfully,

O. H. ERNST,
Chairman.
GEORGE CLINTON,
Member.
E. E. HASKELL,
Member.

Hon. W. H. TAFT,
Secretary of War.

REPORT BY CAPT. CHARLES W. KUTZ, CORPS OF ENGINEERS.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
WASHINGTON, August 15, 1906.

GENERAL,—1. In compliance with the written orders of the Secretary of War, dated July 14, 1906 (copy attached marked A), and your subsequent oral instructions,

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I have the honour to submit herewith the following report upon the existing power situation at Niagara Falls :—

2. The information called for by the Secretary of War concerns not only the power companies now diverting water on the American side, but also those on the Canadian side who are seeking through their associated transmission companies to import power into the United States. This latter information, being of more immediate importance, will be considered first.

3. The four Canadian companies applying directly or through their transmission companies for permits to import power are the Ontario Power Company of Niagara Falls ; the Electrical Development Company of Ontario (Limited) ; the Canadian Niagara Power Company, and the International Railway Company.

THE ONTARIO POWER COMPANY.

4. This company was incorporated by an Act of the Dominion parliament in 1887, and is not limited by its statutory rights to the production of any given amount of power. All its plans, however, are subject to the approval of the commissioners for the Queen Victoria Niagara Falls Park. The present approved plans were designed for the production of 180,000 electrical horse-power, using its Niagara river intake. In addition to its Niagara river rights, the Ontario Power Company has a franchise for taking water from the Welland river, but beyond the purchase of a limited amount of land for right of way for the intake tunnel or canal this franchise has not yet been exercised.

5. The Niagara river plant as designed consists of headworks located above the first line of rapids, three main conduits or flumes 6,000 feet or more in length, leading the water through the park to a point below the falls, thence by penstocks in tunnel through the cliff to the generating station in the gorge, and lastly a distributing station or transformer house situated on the high bluff directly above.

6. The headworks are constructed for the full development; that is, 180,000 electrical horse-power. Only one of the three main conduits has been built, and this has a capacity sufficient, it is claimed, to supply water to 6 generating units, 3 with a capacity of 10,000 electrical horse-power each, and the remaining 3 with a capacity of 12,000 electrical horse-power each. The valve chamber of No. 1 conduit is complete for 7 units except 3 valve motors, and rough excavation has been made for the valve chamber of No. 2 conduit in which an eighth valve has been installed, so that No. 7 can be operated either from No. 1 or No. 2 conduit. Excavation for the power-house is complete for 8 units, the foundation and structure for 6 units. The central or main portion of the transformer house was designed and built for the control of 22 units, the number originally planned for the completed plant. The wings of the transformer house as now built have a capacity for 8 transformer sets, corresponding to 8 generator units. Four transformer sets are now installed. In addition, room is provided in the central part of the building for the passage of 4 additional transmission lines without change of voltage.

7. The books of this company show an expenditure of \$5,142,000, exclusive of rentals and rights, with \$400,000 due on uncompleted contracts. This total expenditure on power plant of \$5,542,000 will complete the installation of 4 units. The installation of 2 additional units, orders for which have recently been given, will require an additional expenditure of \$315,000. Of the 4 units now installed, 3 are ready for service, and the fourth lacks only a minor part to make it complete. The order for the fifth and sixth units calls for delivery within twelve months. The estimate furnished by the company of the cost of completing the approved design is \$6,500,000.

8. In addition to the expenditure of the Ontario Power Co. itself, there has been expended by the Ontario Transmission Company nearly \$1,000,000 in real estate, transmission lines, stations, &c. For financial reasons a separate organization is maintained, but the company is practically identical with the Ontario Power Company. It owns

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an interest in the transformer house and owns all the transmission lines in Canadian territory. The Ontario Power Company has Canadian contracts for about 6,000 horse-power, with the option on the part of the purchaser to increase the amount to about 13,000 horse-power. It has a contract with the Niagara, Lockport and Ontario Power Company to deliver at the international boundary for use in the United States 60,000 horse-power, with the option on the part of the purchaser of increasing the amount to 180,000 horse-power. The latter contract is dated July 16, 1904, and provides that the 60,000 horse-power shall be delivered on or before January 1, 1907, with the option on the part of the purchaser of taking 60,000 additional horse-power January 1, 1911, and the third 60,000 horse-power on January 1, 1915.

9. The Niagara, Lockport and Ontario Power Company is building, switching and transforming stations and constructing transmission lines for the purpose of carrying out its contract with the Ontario Power Company. In furtherance of its plans the company has acquired a private right of way containing about 3,200 acres of land, with an unbroken strip 300 feet wide from the Niagara river to Lockport, a distance of 17 miles; thence 200 feet wide to the suburbs of Rochester, a distance of 55 miles; thence 100 feet wide from the suburbs of Rochester to Fairport, a distance of 12 miles. In addition, a similar private right of way, owned in fee simple 100 feet wide, has been acquired from Lockport southward through the suburbs of Buffalo to the Lackawanna Steel Company's plant, a distance of 27 miles. The company has erected two transmission lines from the international boundary to Lockport, each with a capacity of 30,000 horse-power. From Lockport to Syracuse a single line partly over the right of way of the West Shore railroad has been completed, with a capacity of 10,000 horse-power, and a second line of greater capacity is under construction. On the double line from Lockport to Buffalo work is in progress, 60 per cent of the poles having been erected. Each of the Buffalo lines is to have a capacity of 30,000 horse-power.

10. The books of this company show an expenditure of \$2,785,000, of which \$1,200,000 is represented by right of way and \$1,162,000 is represented by construction. The Niagara, Lockport and Ontario Power Company has actually executed contracts which call for the delivery within the near future of 6,000 horse-power, with provision for fixed increases at intervals varying from three months to three years, so that at the expiration of that time they will have a firm contract with their present customers for 14,240 horse-power, with options on the part of the purchasers which give them the right to increase the amount to 70,000 horse-power. The first of these contracts is dated June, 1905, three others in the fall of 1905, one in March, two in April, and two in May, 1906. In addition the company claims to have contracts verbally closed for 13,000 additional firm horse-power, and negotiations pending for 25,000 firm horse-power, making a total of 52,000 horse-power, for which they hope to have a market in the near future. The optional amounts named in these contracts and negotiations aggregate 166,000 horse-power. At the time of the examination, this company was actually transmitting to the United States 700 horse-power.

THE ELECTRICAL DEVELOPMENT COMPANY.

11. This company was incorporated by Act of the legislature of Ontario (5 Edward VII., ch. 12), for the purpose of developing, distributing and selling electrical power and for other purposes, but its charter gives it no specific right to take water from the Niagara river or its tributaries. To this company was assigned an agreement which three citizens of Canada had entered into with the commissioners for the Queen Victoria Niagara Falls Park, by virtue of which it is authorized to take from the Niagara river, water sufficient to develop 125,000 electrical horse-power. The amount of water for this purpose is computed to be 10,800 cubic feet per second.

12. In pursuance of this agreement, a plant has been designed and partially constructed that will be capable of producing the full amount of power authorized. The headworks are completed except for the removal of the cofferdam, while the wheel-pit

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and tailrace tunnels are practically completed for the full development. Contract has been entered into for the construction of two-thirds of the power-house structure. The metal work of this part of the building is practically completed and the stone work 50 per cent completed. This will provide cover for 7 of the 11 units that are projected, each of which is designed with a capacity of 12,500 electrical horsepower. Only four generating units have actually been ordered. Two of the four have been delivered at the power house and are now being installed; one of the two was being made ready for test at the time of the examination, and unless some unforeseen accident occurs should be ready for service during the month of September, and the other three at intervals of six weeks to two months thereafter. The transformer house as constructed is for 5 units. One bank of three transformers is on the ground, a second bank was scheduled for shipment August 1, and the third bank August 15. By its headworks, wheel-pit and tailrace development the company is committed to the installation of 11 units, by its power house to the installation of 7 units, and by its contracts for machinery to the installation of 4 units.

13. The books of the company show an expenditure to July 1, 1906, on the power plant of \$4,500,000. The liabilities, incurred and unpaid, for completing the installation of 4 units are \$1,760,000, a total investment in plant of \$6,300,000. To complete the installation of 11 units would cost \$1,576,000.

14. This company has affiliated with it the Toronto and Niagara Power Company, organized for the purpose of transmitting power from Niagara Falls, Ontario, to Toronto. Its transmission lines, which except for a short section are completed, will have a capacity of 20,000 horse-power, and represent an investment of \$1,870,000, with \$750,000 required for completion. The demands on this company from Toronto and intermediate territory will probably aggregate between 30,000 and 40,000 horse-power. The Electrical Development Company was organized primarily for the purpose of furnishing power to Canadian points, and its arrangements for selling power in the United States are in a more or less embryonic state. For distribution in the United States there was organized the Electrical Transmission Company of Niagara Falls, a corporation chartered under the laws of the state of New York. This company at present is a mere holding company, keeps no books, and all the expenditures made in its name have been advanced by the Electrical Development Company. The books of the Electrical Development Company show an expenditure on this account of \$246,000, which was used for the purchase of an interest in the Niagara Falls Gas and Electric Light Company, Niagara Falls Gas Company, and the Albion Power Company, and for the purchase of real estate in Niagara Falls, \$40,000 being the amount of the last item. This investment, together with the holdings of the 'Nicholl Syndicate,' a group of men who control the Electrical Development Company, gives control of these subsidiary companies to the power company.

15. The value of the properties thus controlled is approximately \$1,000,000. The Niagara Falls Electrical Transmission Company also has an agreement with the International Railway Company looking to the building of a bridge crossing the Niagara river to be owned jointly by the two companies, across which it is proposed to convey power that is sold by the Electrical Development Company to the Niagara Falls Electrical Transmission Company. Negotiations with this company (I. R. R. Co.) also contemplate the granting to the transmission company of a right of way for its transmission lines over the right of way now being acquired by the railway company between Niagara Falls and Buffalo. This agreement with the International Railway has not yet assumed the form of a written contract. For carrying its transmission lines to Rochester this company proposes to use the right of way of the Buffalo, Lockport and Rochester Electric Railway. There is no contract to this effect, but as the Buffalo, Lockport and Rochester Railway is controlled by the Nicholl Syndicate above referred to, there is a community of interest. The Buffalo, Lockport and Rochester Railway is now under construction, the contract for grading a double-track road and for the construction of a single-track road having been entered into with J. G.

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White & Company, contractors, on May 14, 1906, at a cost of \$2,250,000. In addition to the above the Electrical Transmission Company has acquired franchises in its own name in seven cities and towns in western New York for the sale and transmission of power, and through the Niagara Falls Gas and Electric Light Company and the Albion Power Company it controls twenty other such franchises. The Niagara Falls Electrical Transmission Company has not executed any contracts for the delivery of power, but expects that its allied interests will require 17,500 horse-power. This expectation is based on the use by the Niagara Falls Gas and Electric Light Company of 3,000 horse-power, though the amount now distributed by this company is about 100 horse-power. It also includes an estimate of 4,000 horse-power for the Buffalo, Lockport and Rochester Railway Company. This amount is based on a double-track road, while the contract for the construction of the road calls for only a single track at the present time. The company also submitted confidentially a list of corporations which had made inquiries with reference to the purchase of power from the Niagara Falls Electrical Transmission Company, together with the amount of power which they would probably require. This list aggregates 141,000 horse-power. It is needless to say that these inquiries involve no obligation on the part of either party.

THE CANADIAN NIAGARA POWER COMPANY.

16. This company was incorporated by an Act of the legislature of the province of Ontario in 1892, and is not limited by its statutory rights to the production of any given amount of power. All its plans, however, are subject to the approval of the commissioners for the Queen Victoria Niagara Falls Park. The present approved plans were designed for the production of 121,000 horse-power; that is, 11 units each with a capacity of 11,000 horse-power. Regarding one of these units as a spare, so as to put it on the same basis with the two companies previously described, the nominal capacity of the completed plant may be taken at 110,000 horse-power. This company also claims the right to double this plant, basing the claim on that clause of the original charter which limits its occupation of park lands to a length of 1,200 feet, the length of the power-house now designed being 600 feet. As this right has in no way been exercised, and as it could not be exercised without the approval of the park commissioners, it need not be further considered.

17. This plant operates under an effective head of 141 feet, and for the development of 110,000 horse-power will require about 9,500 cubic feet of water per second. The head works consist of a head canal with a fore bay of 600 feet wide extending the whole length of the power-house. The headworks, gates, wheel pit, and tailrace tunnel are completed for the full development. Five generating units are completely installed and a portion of the power-house sufficient to cover them has been completed. The transformer station is also of sufficient size to accommodate five units. By its headworks, wheel pit and tailrace development the company is committed to the installation of 11 units; by its power-house and transformer house to the installation of five units.

18. The books of the company show an investment to July 1, 1906, including liabilities incurred and unpaid for completing the installation of five units, amounting to \$6,250,000. For comparative purposes the value of the franchise, given as \$900,000, should be deducted, making the cost of the installation \$5,350,000. To complete the installation of 11 units would cost probably \$1,250,000.

19. This company is an allied company of the Niagara Falls Power Company, and save for the maintenance of a separate organization, is identical with it. It expects to market practically all its power through the Niagara Falls Power Company, or through the latter's agents. An underground conduit, with a capacity of 128,000 horse-power, connects it with the plant of the Niagara Falls Power Company, and cables with a capacity of 32,000 horse-power are now installed. A separate transmission line, capacity 25,000 horse-power, running for 16 miles along the west shore of

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the Niagara River to Fort Erie is under construction, together with the towers required to carry the cables across the river to Buffalo. For its transmission lines it has actually expended or is committed by contract to the amount of \$430,000.

20. It is now delivering 1,340 horse-power to Canadian tenants, who have the option of increasing the amount to 4,237 horse-power. At the present time there is no definite contract covering the sale of the power intended for delivery in the United States. This is explained by the intimate financial relations existing between the Niagara Falls Power Company and the Canadian Niagara Power Company. At the time of the examination it was actually transmitting to the United States about 16,000 horse-power, but the combined load sheet of the two companies shows that the maximum amount thus far delivered to consumers is about 85,000 electrical horse-power.

INTERNATIONAL RAILWAY COMPANY.

21. This company is incorporated both in the state of New York and in the Dominion of Canada. In its first capacity it owns and operates all the electric railways in the city of Buffalo and adjacent towns, and the city of Tonawanda, Erie county, and the cities of Lockport, Niagara Falls, and the intervening territory in the county of Niagara, N.Y. Under its Canadian charter it owns and operates an electric railway along the shore of Niagara river from Chippawa to Queenston. It also owns two bridges over the Niagara river, one just below the falls and one at Lewiston, over both of which it has specific legislative authority to transmit power.

22. Its power plant is located in the Queen Victoria Niagara Falls Park, which plant was acquired when it acquired the property and franchise of the Niagara Falls Park and River Railway Company. In acquiring this railroad it paid for the equity therein, \$733,000, and assumed a bonded indebtedness of \$600,000, making a total investment of \$1,333,000. It is claimed that this value was fixed largely by the power rights of the Niagara Falls Park and River Railway Company. At the time of its acquisition the power plant represented a cash outlay of \$141,000. Since that time further expenditures have been made upon its power-house and equipment of \$125,000, so that the actual investment of this company in its power property at Niagara Falls, Ontario, is about \$265,000. With the machinery now installed 3,600 electrical horse-power can be generated, the effective head being 68 feet. Under its charter, none of the power may be sold, and its use is limited to operating and lighting the railway, the Canadian division of which now uses from 800 to 1,200 horse-power. The company claims the right to transmit the balance to the United States for use on that portion of its system. This right, however, is questioned by the commissioners of the Queen Victoria Niagara Falls Park, and in their annual report for 1905 they say that they cannot see their way clear to approve the plans for the transmission of this power through the park. The matter has been referred to the Dominion government for decision. While it is understood that some progress has been made towards a solution, final action has not yet been taken.

23. The company, in its application to transmit power to the United States, asks for 8,000 horse-power, the intention being to enlarge the power plant for this purpose, at an estimated cost of \$150,000. Pending the determination by the Dominion government of this company's rights, it is believed that no permit should be granted to them. Having in mind, however, the fact that they are now generating 2,500 horse-power more than they can use on the Canadian side, and the fact that the transmission of this power to the United States would result in an estimated saving of \$30,000 a year, it would seem equitable to reserve 2,500 horse-power for the present of the 160,000 horse-power for which permits can be granted, so that a permit for this amount could be issued in case the present controversy is decided in favour of the railway company.

24. The principal facts with reference to the three big Canadian companies are tabulated as follows:

	Ontario Power Co.	Electrical De- velopment Co.	Canadian Niagara Power Co.
Expenditures to date in power plants, exclusive of rights and franchises.....	\$5,142,000	\$4,500,000	\$4,672,000
Amount required to complete existing contracts and orders.....	\$715,000	\$1,760,000	\$678,000
Amount required to complete plants to projected size.....	\$6,500,000	\$1,576,000	\$1,250,000
Effective head.....feet	180	135	141
Capacity of generating machinery actually installed, electrical horse-power.....	42,000	.....	55,600
Nominal capacity of generating machinery installed and ordered.....electrical horse-power	66,000	50,000	55,000
Nominal capacity of projected plants....."	180,000	125,000	110,000
Amount invested and obligated for Canadian transmission lines... ^a	\$1,000,000	\$2,620,000	^a \$430,000
Probable sale of power in Canada.....horsepower	10,000	30,000	5,000
Amount of water required for machinery installed and ordered, including exciter sets—efficiency of the unit being taken at 76 per cent. ....cubic feet	4,250	4,300	4,500
Amount of water required for plants as projected....."	11,700	10,800	9,500
Actual expenditures by their associated American transmission companies.....	\$2,785,000	^b \$246,000	\$600,000

^a The major portion of this amount has been expended in the construction of transmission lines intended for delivery of power to the United States distributing companies.
^b This does not include any expenditures by the Nicholl Syndicate.

25. If these companies were limited in their output to the capacity of the generating machinery now actually installed and ordered, their investment in power plant exclusive of franchises per horse-power developed would be approximately as follows:

Ontario Power Company.. . . .	\$ 89 00
Electrical Development Company.. . . .	125 00
Canadian Niagara Power Company.. . . .	97 00

If permitted to develop to the limit of their approved plans the investments in power plant per horse-power developed (nominal capacity) would be:

Ontario Power Company.. . . .	\$68 00
Electrical Development Company.. . . .	62 00
Canadian Niagara Power Company.. . . .	60 00

These figures must be considered as only approximately correct, owing to the different methods of cost distribution used by the several companies. The aim has been to take the actual cost of the power plants exclusive of rights, rentals and franchises. Regardless of their absolute accuracy, or even their relative accuracy as between the three companies, they serve to show the extent to which the companies by their expenditures and contracts have committed themselves, and also the approximate losses which they will sustain if they are limited to the production of an amount of power less than their projected capacity. All three of these power developments were undertaken in good faith several years ago and long before the agitation in Congress which led to the passage of the present law, and there is no evidence that any of their subsequent transactions were made with the object of securing rights which they had not always intended to claim.

26. The total capacity of the generating machinery installed and ordered for the three plants is 171,000 horse-power. The probable demand in the near future from Canadian markets will not exceed 40,000 horse-power, leaving 131,000 horse-power for sale in the United States. The granting of permits for this amount would permit the utilization to its full capacity of all machinery now installed or ordered, but would not permit any further development and would not afford a reasonable return on the moneys now invested unless the prices to the consumers were measurably increased. In order that such relief as is now possible may be afforded, it is recommended that

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permits be granted for 157,000 horse-power, the maximum amount under the first limitation, less 2,500 horse-power reserved for the International Railway Company.

27. The conditions surrounding the development of the Canadian power companies differ so materially that an exact statement of their relative rights to the American market is not possible. The Niagara, Lockport and Ontario Power Company, the distributing agent in the United States for the Ontario Power Company, has expended a large sum in opening up a new market. The Electrical Development Company started primarily to develop the Canadian market, and its plans for the American market have not yet been fully matured, while the plant of Canadian Niagara Power Company is virtually an addition to that of the Niagara Falls Power Company. Considering alone the investments in power plant, there is no apparent reason why any distinction should be made between the power companies in the amount of power which they should be permitted to send into the United States. While the projected development of the Ontario Power Company is considerably greater than that of the other two companies, this apparent advantage is balanced by the fact that the other two companies are more fully committed by expenditures already made to the complete development. If the relative investments of the three transmission companies associated with them for distribution in the United States are alone considered, the claims of the Niagara, Lockport and Ontario Company are unquestionably superior to those of the other transmission companies. As the object of the law is to restrict, directly or indirectly, the amount of water diverted, it has been suggested that some weight should attach to the fact that the Ontario Power Company makes greater use of the water that it diverts than either of the other companies. Each of the companies, however, fully utilizes the head incident to its geographical location, and any distinction in the matter of permits based on relative natural advantages would appear to be unjust.

28. The Electrical Development Company had for its primary object the furnishing of power to various points in Canada, as is indicated by the construction of its Toronto line, yet the demand for electrical power in Canada within the economical radius is so limited as to make it unreasonable to suppose that this company had given no thought to the marketing of a part of its power in the United States. The Electrical Development Company is planning to sell between 30,000 and 40,000 horse-power in Canada, which is probably from 20,000 to 25,000 horse-power in excess of what either of the other two companies will sell in Canada, a fact which should receive consideration in fixing the amount to be transmitted to the United States. On the other hand, any greater discrimination against the Electrical Development Company, which is owned almost wholly by Canadian capitalists (the other two companies being owned almost wholly by Americans), may give rise to a feeling of resentment on the part of the people of Canada and tend to retard the negotiation of a treaty between the two countries concerning the preservation of Niagara Falls.

29. The application for permits made by the transmission companies are as follows:—

	Horse-power.
Niagara, Lockport and Ontario Company, from the Ontario Power Company..	90,000
Electrical Transmission Company, from the Electrical Development Company..	62,500
Niagara Falls Power Company, from the Canadian Niagara Power Company..	121,500

The application of the Niagara, Lockport and Ontario Company is based upon the desire to secure a reasonable return on the investment already made, but considering the date named in its contract with the Ontario Power Company for the delivery of the second block of 60,000 horse-power, *i.e.*, January 1, 1911, and having in mind the fact that any production of power in excess of 66,000 horse-power means the con-

struction by the Ontario Power Company of a second conduit and a consequent expenditure of \$3,250,000, it is believed that a present limitation to 60,000 horse-power will not work undue hardship.

30. The application of the Electrical Transmission Company contemplates the marketing of one-half of the total output of the Electrical Development Company. Considering the situation of the latter company in the Canadian market and the limited extent to which the Electrical Transmission Company has committed itself by its expenditures, a present limitation to 37,500 horse-power does not appear to be inequitable.

31. The plant of the Canadian Niagara Power Company is intended to supplement that of the Niagara Falls Power Company, and a fair estimate of the rapidity with which its power will be marketed is found in the rate of growth in the past of the Niagara Falls Power Company. This has amounted to about 20 per cent in recent years, with a present output of both companies amounting to 85,000 horse-power. Assuming that the same rate of growth will continue, though in all probability it will be reduced owing to power which the other companies expect to market in this territory, it will be two or three years before the full capacity of the Canadian plant as now installed will be utilized. For these reasons a present limitation to 60,000 horse-power will not, in my judgment, seriously interfere with its normal development.

32. If permits are granted for these amounts, the Ontario Power Company would be justified in installing a seventh unit as a spare, the Canadian Niagara Power Company would be justified in installing two more units, one as a spare, making the nominal capacity of its plant 66,000 horse-power. The Electrical Development Company would be justified in installing three more units, one of them a spare, making the nominal capacity of its plant 75,000 horse-power, half of which, the proportion asked for, it would be permitted to transmit to the United States. If each installs these units, the relative investment in power plant, exclusive of franchise, per horse-power developed (nominal capacity) would be :

Ontario Power Company..	\$92 00
Electrical Development Company..	91 00
Canadian Niagara Power Company..	87 00

33. Based upon what precedes, it is recommended that permits for the transmission of power to the United States be issued as follows:—

	Horse-power.
Niagara, Lockport and Ontario Company, from the Ontario Power Company..	60,000
Electrical Transmission Company, from the Electrical Development Company..	37,500
Niagara Falls Power Company, from the Canadian Niagara Power Company..	60,000
	<hr/> 157,500

In order that the various companies may proceed with this limited development, it is further recommended that permits for such amounts as may be authorized be issued without delay.

34. As to the question of granting transmission permits for amounts additional to the first 160,000 horse-power, it is believed to be the intent of the law to delay the issue of such permits until it is known what appreciable effect, if any, will be produced on the falls by the diversion of the amount of water that will be used under the first limitation. If this interpretation of the law is correct, the granting of such permits will be a matter for the future, as it will be fully a year before the companies will be in a position to develop 160,000 horse-power, in addition to the amounts sold in Canada.¹

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35. The information contained in this partial report was obtained from the parties interested, and its important features verified by a personal inspection of the works and a general examination of the books and records of the various companies. These inspections and examinations were made July 20 to July 28, 1906, and descriptions of the power plants of the Ontario Power Company (Appendix B), Electrical Development Company (Appendix E), and the Canadian Niagara Power Company (Appendix G), and of the transmission lines of the Ontario Transmission Company (Appendix C), Niagara, Lockport and Ontario Power Company (Appendix D), and the Toronto and Niagara Power Company (Appendix F), in greater detail than in the body of the report, are appended hereto. They were prepared by Mr. Earl Wheeler, E.E., who, with Mr. F. D. C. Faust, a representative of the Department of Justice, assisted in the examination. A photographic copy of a map of Niagara Falls, taken from a monograph prepared in 1904 by the Canadian Society of Civil Engineers, is also appended.*

36. The preparation of that part of the report which concerns the diversion of water on the American side has been delayed by the non-receipt of certain information, and will be submitted later.

Very respectfully,

CHARLES W. KUTZ,
Captain, Corps of Engineers.

Brig. Gen. A. MACKENZIE,
Chief of Engineers, U.S.A.

APPENDICES.

APPENDIX A.

MEMORANDUM OF THE SECRETARY OF WAR.

WAR DEPARTMENT, WASHINGTON, July 14, 1906.

In the matter of the applications for permits under the Act entitled 'An Act for the control and regulation of the waters of the Niagara River for the preservation of Niagara Falls and for other purposes,' approved June 29, 1906.

On the 5th day of July, 1906, in response to applications by the Niagara Falls Power Company and the Niagara, Lockport and Ontario Power Company, a preliminary hearing was had in Washington, D.C., at the office of the Secretary of War, at which were represented the following companies: Ontario Power Company of Niagara Falls, Gen. F. V. Greene, vice-president; Niagara, Lockport and Ontario Power Company, represented by the firm of Cravath, Henderson & de Gersdorff; Niagara Falls Hydraulic Power and Manufacturing Company, Geo. B. Matthews, president; Niagara Falls Electrical Transmission Company, Frank A. Dudley, vice-president; Electrical Development Company of Ontario (Limited), represented by H. H. Macrae; Niagara Falls Power Company, represented by F. L. Lovelace, secretary; Canadian Niagara Power Company, represented by F. L. Lovelace; Niagara Falls Trust Company, representing estate of H. E. Woodford, represented by Frank A. Dudley; Albion Power Company, represented by Frank A. Dudley.

Merely general statements were made, and upon the application of Mr. Stetson, counsel for the Niagara Falls Power Company, and Mr. John G. Milburn, counsel for the Niagara Falls Hydraulic Power and Manufacturing Company, and with the consent of the other parties, a subsequent day for a fuller hearing was fixed on the 13th day of July, at the office of the Secretary of War in Washington, and all parties in interest were required to file their applications and claims for permits, whether for diversion of water on the American side or transmission of electrical power from

* Omitted in this report.

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the Canadian side, before the 10th of July with the Secretary of War. Subsequently, and in order that the Secretary of War might visit the *locus in quo*, and understand more clearly the situation, the date of the hearing was changed from July 13 to July 12, at 10 o'clock, in the parlours of the International Hotel at the city of Niagara Falls. Notices of this hearing had been sent to every person known to have any interest whatever in the withdrawal of water from the Niagara river, its tributaries, or the Erie canal, and coming within the provisions and limitations of the law. At the meeting at Niagara Falls the following corporations and individuals were present or represented by counsel.

The Niagara Falls Power Company; the Niagara Falls Hydraulic Power and Manufacturing Company; Canadian Niagara Power Company; the Ontario Power Company of Niagara Falls; Niagara, Lockport and Ontario Power Company; the Niagara Falls Electrical Transmission Company; the Electrical Development Company of Ontario; Albion Power Company; Niagara Falls Trust Company, as executor and trustee of the estate of Henry E. Woodford, deceased; the Niagara Gorge Railroad Company; the Niagara County Irrigation and Water Supply Company; the Lockport Hydraulic Company; the United Box Board and Paper Company; the Lockport Paper Company; the Niagara Paper Mills; Westerman & Company; Arabella A. Peterson; the Electric Smelting and Aluminum Company; International Railway Company; the Cataract Hotel Company; Mr. J. Howard Mason, secretary of the Chamber of Commerce of Buffalo; Mr. J. Horace McFarland, president of the American Civic Association of America.

In addition to the persons making applications for the permits, Mr. J. Horace McFarland, representing the Civic Association of America, which had taken an active interest in securing the passage of the law and in the preservation of the integrity and volume of Niagara Falls, was also present and made argument to the secretary on behalf of the public.

There were present to assist and advise the Secretary of War at this hearing, Brigadier-General Mackenzie, Chief of Engineers, U. S. Army, Brigadier-General Ernst, U. S. Army (retired), and member of the American section of the International Waterways Commission, and Mr. George Clinton, of Buffalo, counsellor at law and member of the American section of the International Waterways Commission.

Every person present desiring to present his claims was heard, and stenographic notes were taken of the arguments and applications, and the hearing continued from 10 o'clock in the morning until 2 in the afternoon.*

MEMORANDUM OPINION BY THE SECRETARY OF WAR.

The purpose of the law is to preserve the integrity and volume of the Niagara river which goes over the Niagara Falls, and it contemplates the issuing of permits for the withdrawal of water from the river on the American side, and the issuing of another class of permits for the transmission from the Canadian side, and importation into the United States of electrical current generated by water-power plants on the Canadian side. This latter class of permits is required doubtless on the theory that the restriction of the importation of electrical current will have the indirect effect of restricting the use of water for the production of power on the Canadian side of the Niagara river. Speaking generally, there is an investment of capital of about twenty odd million dollars on the American side, and of about an equal amount on the Canadian side, and the effect upon the profit from this investment by the action of the Secretary of War under the law may be very serious. On the other hand, the public interest in and importance of the preservation of the integrity and volume of the Niagara river are shown by the passage of the Act itself, and the very stringent provisions with reference to its violation contained therein.

* The report of the hearings at Niagara Falls is printed as War Department Document No. 280.

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Congress has deputed to the Secretary of War the task of reaching in his permits an equitable result by which the integrity and volume of the Niagara river shall not be seriously impaired, on the one hand, and the capital which has been really invested and involved in the structures now entered upon and the plant now contracted for and the contracts now made may not be so injured in its profit-producing as that this Act may operate as a practical confiscation of property. Even if Congress had the power by legislation of this character practically to destroy the capital which had been invested in power-producing plants, as to which it is not necessary to express an opinion, I feel certain, from the character of the language used, that it was not the intention of Congress to do so. It becomes of the utmost importance, therefore, before the Secretary of War shall decide upon the permits to be granted, that there should be brought to his knowledge exact information with respect to the capital which has been invested in all the power plants, the extent to which these plants are in actual use, the amount of cubic feet of water actually in use, the amount of electrical power actually generated, the contracts made by these companies for the furnishing of power, the dates when the contracts were made, the charters of the companies, and their statutory powers, the extent of horse-power which under their charter or statutory powers they might produce, the amount of actual construction completed, the amount of money invested in partially completed plants, the amount necessary to complete them, the amount of electrical current now being furnished, the amount which can be reasonably furnished with the plant under construction, and the amount that can be sold in the existing markets by these companies and all the other circumstances tending to reflect on the effect which a limitation by a permit will have upon their business.

The limitation upon the permits which the Secretary of War is authorized to grant for diversion of water from the Niagara river for six months is 15,600 cubic feet a second. Of that it is undisputed that the Niagara Falls Power Company is now, and has for some time past, been using and selling 8,600 cubic feet per second. It is also undisputed that the Niagara Falls Hydraulic Power and Manufacturing Company has been using 4,000 cubic feet a second. It is also in evidence, and not disputed, that it is engaged in the construction of an additional plant in which it has already expended considerably more than a million dollars under a contract to furnish to the Pittsburg Reduction Company the electrical horse-power from the use of 2,400 cubic feet of water a second. It is also in evidence that the Lockport Hydraulic Company is drawing 500 cubic feet a second from the upper level of the Erie canal, the same level as the level of Lake Erie, carrying it around the locks and discharging it again into the Erie canal below Lockport; and that the following companies—the United Box Board and Paper Company, Lockport Paper Company, Niagara Paper Mills, Westerman & Co., Arabella A. Peterson, and the Electric Smelting and Aluminum Company—from the next level of the canal below the high level at Lockport are drawing 333 cubic feet of water a second, which they are discharging into Eighteen-mile Creek and thence into Lake Ontario.

As the law has immediate operation, and as none of this water can be withdrawn on the American side without a permit from the Secretary of War, it is of course necessary to prevent the companies from being put in the position of law-breakers by withdrawing the water which it is absolutely necessary to withdraw to maintain the present *status quo*, and temporary permits must be issued for that purpose. Accordingly a temporary permit is hereby granted to the Niagara Falls Power Company to withdraw from the Niagara river 8,600 cubic feet of water per second until further action by the Secretary of War. The Niagara Falls Hydraulic Power and Manufacturing Company is hereby authorized to withdraw 4,000 cubic feet a second until further order of the Secretary of War. This company is not now using the 2,400 cubic feet a second, a permit for which is asked for on behalf of it and the Pittsburg Reduction Company, and it is probable that a final decision may be reached before this order needs to be issued, if it is to be issued at all. With reference to the Lockport Hydraul-

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lic Company, a permit will issue for the drawing of 500 cubic feet of water from the Erie canal, and permits will also issue for the use of the 333 cubic feet of water from the lower level of the same canal at Lockport by the persons mentioned above, although in my judgment these permits thus made for 833 cubic feet of water are really duplications, so that a permit ultimately for 500 cubic feet of water will cover all the water used by the persons drawing water from the Erie canal in and about Lockport. With respect to the application of the Albion Power Company, I expressed at the hearing the opinion, which I still hold, that its use of the water does not come within the law, and for the present that will be the holding of this department.

With reference to the application of the Niagara Falls Trust Company as executor and trustee of the estate of Henry E. Woodford, deceased, there seems to be no necessity for granting a temporary permit, for the water is not being used, and it is questionable whether a permit is necessary, and, therefore, consideration of this question will be postponed until final decision.

A controversy with respect to permits is likely to arise over the transmission of electricity from the Canadian side, and its importation into the United States. The first limit in the law is the transmission of 160,000 horse-power, and the applicants for permits reach the total of 281,500. These applications are as follows:

	Horse-power.
Niagara, Lockport and Ontario Power Company (Ontario Power Company of Niagara Falls)	90,000
Niagara Falls Power Company (Canadian Niagara Power Company)	121,000
Niagara Falls Electrical Transmission Company (Electrical Development Company of Ontario)	62,500
International Railway Company	8,000
	<hr/>
	281,500

It is necessary that the Secretary of War should know, before final action is taken by him, in the matter of permits for transmission, the capital already invested in the Canadian companies, the degree of completion of the plant, the amount likely to be sold on the Canadian side of the current, the time when the plant shall be ready for operation, the amount now actually produced, the amount now actually transmitted to the United States, the amount invested not only in the production of the current, but in the plant and machinery for its transmission, including the poles and wires, and all the details; and also the capital invested by the American companies who are to receive in the first instance the current thus produced, the form in which that capital is, and the contracts into which they have entered both with the Canadian companies and with the companies or persons to whom they expect to sell the current, the dates of these contracts and all the circumstances tending to show the extent of the injury that a refusal to grant the permits requested would cause to the investment of capital, together with the question of when the contracts were made upon which the claims for the use of current are based, with a view to determining the good faith with which these contracts were entered into, and whether the threatened passage of the law induced their making.

For the purpose of advising the Secretary of War upon the facts and circumstances hereinbefore referred to, the importance of which has been pointed out, Capt. Charles W. Kutz, of the Corps of Engineers, under the direction of the Chief of Engineers, is hereby ordered to institute an investigation bearing upon all the questions hereinbefore described. He is authorized, with the approval of the Chief of Engineers, to employ an expert accountant at a reasonable rate of pay to assist him in the examination which he is directed to make, and to incur other necessary expenses to be paid out of the appropriation of \$50,000 made by the Act of Congress under which this proceeding is had.

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A full report upon the questions presented will be submitted to the Secretary of War, through the Chief of Engineers, at as early a date as a thorough investigation and consideration will permit; and this report will thereafter be submitted to the American members of the International Waterways Commission for consideration and recommendation.

So far as I can determine from the statements of fact in the printed applications and in the oral statements, at present electrical current is not being produced on the Canadian side for use upon the American side, except by the Canadian Niagara Power Company and the Ontario Power Company of Niagara Falls. The Canadian Niagara Power Company is producing and transmitting about 16,000 horse-power daily, while the Ontario Power Company is certainly not exceeding this, though the capacity of both companies for production and transmission when the plants which are under construction are completed, as they will be in the near future, will much exceed these amounts. For this reason I hereby grant a temporary permit to the Niagara Falls Power Company to take by transmission from the Canadian Niagara Power Company not to exceed 25,000 horse-power of electrical current daily. I hereby grant a permit to the Niagara, Lockport and Ontario Power Company the right to receive and take by transmission into the United States electrical current equivalent to 25,000 horse-power daily from the Ontario Power Company of Niagara Falls, Canada. It is thought by the permits hereinbefore granted that the *status quo* will be maintained without injury either to the public or to the private interests concerned.

A copy of this order will be sent to all the parties in interest, including Mr. J. Horace McFarland, president of the American Civic Association.

WM. H. TAFT,
Secretary of War.

APPENDIX B.

THE WORKS OF THE ONTARIO POWER COMPANY OF NIAGARA FALLS.

The present design consists of headworks located in the smooth water of the upper river above the first line of rapids and opposite the Dufferin Islands; three main conduits which lead the water through the park to a point on the cliff below the falls to the valve chamber, thence by penstocks in vertical tunnels through the cliff to a point on a level with the turbines in the power-house, from which point it is carried through horizontal conduits to the turbines; a generating station in which are the turbines and generators; and lastly a distributing station on the high bluff above, to which the electric cables are carried from the generating station in inclined tunnels.

The design that is at present being carried out is for the development of 180,000 electrical horse-power.

THE HEADWORKS.

The headworks consist of an intake proper, an outer fore bay, a screen house, an inner fore bay and gate house. The main intake, which is 618 feet long, consists of concrete piers supporting a continuous reinforced concrete curtain wall, which extends vertically downward 7 feet below the normal surface of the river and within 6 feet of the river bed and upward 5 feet above the normal river level, which has an elevation of about 560 feet above sea level. The intake proper makes an acute angle with the direction of flow of the water in the river of about 30°.

The outer fore bay has for its boundary the original river bank and an artificial island on one side, and the intake and overflow dam on the other. This fore bay has an area of about 8 acres. The gathering wall or overflow dam, except in extremely low stages of water in the river, will be constantly submerged, water spilling freely over it into the river as over a weir. The main portion of the wall has an elevation of 553 feet above sea level. The last 100 feet of this wall adjacent to the screen house is constructed with the top somewhat depressed below the crest of the main portion.

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This allows a much heavier flow of water adjacent to the screen house for ice-clearing purposes, while it also creates a strong current across the front of the screen. The screen house contains the main screens for the inner fore bay, which screens are in the form of steel grillage set on inclined guides in concrete masonry and are removable by means of an electrical travelling crane. The screens are covered by an artificial stone building, the roof of which forms a broad promenade which is open to the travelling public. The inner fore bay, which extends from the screen house to the gate house, has an area of approximately 2 acres. The landward and river walls are partly formed by excavation in the rock and partly by concrete. The elevation of the water in the inner fore bay is 560 feet.

The quantity of water which will be drawn into the inner fore bay when the entire capacity of the plant is to be generated has been estimated to be about 12,000 cubic feet per second. The depth of water at the intake in the outer fore bay is about 13 feet, while at the intake to the gatehouse it increases to approximately 30 feet.

The gatehouse is completed for the three main conduits, one of 18 feet diameter and the other two of 20 feet each. There are installed at present in this building the gate for the 18-foot conduit only. The screens, however, are complete for all three main conduits. The elevation of the centre line of pipes at the head block is 534 feet. The gates and screens are covered by a substantial building, and boilers and steam pipes are installed for heating both screen and gatehouses.

MAIN CONDUITS.

From the gatehouse to the valve chamber, a distance to the nearest penstock of 6,180 feet, there are to be placed three five-tenths inch riveted and reinforced steel pipes, embedded in concrete, one of 18 feet in diameter and the other two of 20 feet in diameter each. The 18-foot conduit is installed and in operation at the present time. This conduit is capable of carrying 3,900 cubic feet of water per second. The fall between the gatehouse and the spillway or valve chamber is 28 feet. The velocity of water in the conduits is estimated to be approximately 15 feet per second. The conduit now constructed is built of steel plates five-tenths inch in thickness with double-riveted joints: To secure additional thickness seven deck beams are riveted to the upper part of the plate at intervals of 4 feet throughout its entire length. The pipe is erected in a trench excavated in the park.

From the under side of this conduit 7 penstocks, each 9 feet in diameter, drop through vertical shafts and out through horizontal tunnels in the solid rock of the cliff to the generating station. There are four penstocks installed. Each penstock supplies water for a 10,000 horse-power unit. The vertical distance from the centre of the main conduit to the turbine is 133 feet. From this conduit are also two small penstocks of 30 inches in diameter, each leading through an inclined tunnel to the generating station. They supply water to the two exciter turbines.

The plan of the main valve chamber, which is situated beneath the main conduits, is for three separate chambers, each located below its own conduit and opposite the section of the power-house which it controls. There are to be installed in this valve chamber a 9-foot gate valve and operating mechanism for each penstock. There is excavated at present the complete valve chamber for No. 1 conduit and rough excavation for No. 2 valve chamber, which is back filled. There are installed in No. 1 valve chamber 8 valves, one of which is to be connected in No. 2 conduit. There are 7 valves and penstocks connected to No. 1 conduit. An extra valve is installed on the seventh unit so that it can be operated through either No. 1 or No. 2 main conduits. No. 1 valve chamber is therefore complete for 7 units with the exception of valve motors for three of the valves.

THE GENERATING STATION.

The building is of a flat-roof Egyptian architecture, measuring 76 feet wide, 65 feet high, and for the full capacity will be about 1,000 feet in length. The floor

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level is 25 feet above the normal level of the river. There is completed at present the structure and foundation of the generating station for 6 units and the excavation for 8 units. The main generators and their turbines, directly connected, are placed on the main floor of the station. Each unit consists of a pair of Francis turbines mounted on a horizontal shaft, operated at $187\frac{1}{2}$ revolutions per minute, and rated at 11,000 horse-power. They are made by J. M. Voith & Co., Heidenheim, Germany. Before reaching the turbine the penstock supplying it divides into two branches, leading to the runners that constitute one complete turbine. The water flows to casings on the outside of each turbine runner, and then inwardly to the common concrete draft tube, which terminates in a tail race in the foundation of the generating station, which tail-race discharges over a weir wall into the river. The elevation of this weir is 349 feet, and under full-load conditions the water rises to an elevation of 353 feet, giving as a gross head between inner fore bay and tail-race water levels about 200 feet. The value of the effective head on the turbines has ranged from 175 to 190 feet. The engineers of the company state that the effective head at full load is 180 feet.

The first three generators are rated at 7,500 kilowatts, 3 phase, 25 cycle, 12,000 volts. The fourth unit is, and the following units will be, of the same voltage, phase, and frequency, but rated at 9,000 kilowatt capacity. The change in capacity of generators is due to the turbines being of a greater capacity than their designed capacity. The generators are of the horizontal, internal revolving field type, having 16 poles. They are made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

On a raised gallery 11 feet above the main floor and extending along the rear wall of the station are located the exciter units and the governors for regulating the speed of the main turbines. There are two turbo-exciter units, each of 300 kilowatt capacity, giving direct current at 250 volts. The turbines of these sets are 600 horse-power capacity, inward-flow type. Each exciter unit has sufficient capacity for exciting 7 generators. Both of these exciters are being run at the present time; one is carrying direct current auxiliary load throughout the plant and the other the exciting load. There are switch-boards installed in the power-house for controlling the two exciter units and one for service requirements in the valve chamber and power-house, which service includes valve motors, operation of cranes, arc lighting, elevator purposes, and pumps.

There are installed at present 4 main units of a generating capacity of 42,000 electrical horse-power, 3 of which are complete and ready for developing power. The fourth is complete with the exception of a penstock elbow, which will be installed in a few days. The apparatus and switches for controlling the 2 exciter units are complete and installed. There is remaining space in the present building for 2 more generating units of 12,000 electrical horse-power capacity each. The total capacity of plant under contract is therefore 66,000 electrical horse-power.

THE DISTRIBUTING STATION.

At a distance of 550 feet back from the generating station and on a bluff at an elevation of about 250 feet above it is located the transformer and distributing station. These two buildings are connected at present by one cable tunnel from the power house to the valve chamber and one conduit run from the valve chamber to the distributing station. The main controlling cables and service cables are installed complete for four units. There is on the ground cable for two more units. The capacity of this cable tunnel and conduit run is for 8 generating units. Each generator has two cables in parallel, each a 3-phase cable of paper insulation and lead sheathing, with two spiral tapes, and a jute covering over all serving as armour, each copper conductor being of 250,000 circular mils cross section. The cables are laid in tile ducts embedded in the sides of the tunnel. The building of the distributing station is complete for 12 generating units, 8 at high voltage and 4 at low voltage. The control section is com-

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plete for 22 units. The 8 high-tension units are to be placed 4 in each wing; the 4 low-tension units are to be used for distribution at 12,000 volts for the Canadian service, and will be taken through the distributing station on the ground floor of the control section. The upper and central floors of this control section will contain the complete controlling apparatus for 22 units.

There is installed at present in this control section complete control apparatus for 4 units. In an east room the automatic oil switches for the 12,000-volt circuits are mounted in an isolated group for each unit. They are of the 3-pole, vertical magnetically actuated type. The transformers occupy the central room through the length of the building except in the middle, which is the control gallery. Fire-proof masonry walls separate low-tension switch room, control gallery, the two transformer rooms, one in each wing, and the high-tension switch rooms, one in each wing, from one another. There are to be for each unit for high-voltage service a bank of three single-phase transformers, each having a capacity of 2,500 kilowatts. Each bank of three is set in a concrete pit. They are of the oil-insulated, water-cooled type.

The primaries are delta connected for 12,000 volts, and the secondaries for a voltage of 36,000 volts each, so that when Y connected there is a voltage of 60,000 volts between wires. There are to be three pole high-tension switches of special design to break the maximum current of 10,000 horse-power connecting the secondary coils of the transformers to the high-tension bus bars. The high-voltage transmission circuits will be taken off from the bus bars. There are now installed complete in the central portion of the south wing, four sets of transformers for high-voltage service. The north central wing has no apparatus installed at present. The control section has installed control panels and instrument posts for 4 units, 3 panels suitable for 4 high-voltage lines and 2 low-voltage lines. Each of the latter panels is equipped for two transmission lines. There are also installed a direct-current-service switch board and an alternating-current-service switch board for the generating and distributing stations.

APPENDIX C.

THE ONTARIO TRANSMISSION COMPANY.

The Ontario Transmission Company is the distributing company of the Ontario Power Company, in Canada. The capacity of their transmission lines for Canadian distribution aggregates about 6,000 horse-power.

The lines that are installed or are being installed are the following: One circuit to Welland, a distance of 14 miles, the conductor being a 345,000 circular mils aluminum cable, which is equivalent in cross section to a No. 0000 copper cable; two branch lines from Allanburg, which run to St. Catharines and Thorold, the conductors of which are 70,000 circular mils aluminum, and the transmission line is 9.2 miles in length. These two transmission lines are being designed to deliver power at 12,000 volts. The 345,000 circular mils aluminum line, carrying current at 12,000 volts, has a capacity of 3,000 electrical horse-power, with the assumed drop, while the 70,000 circular mils line, at the same voltage and same drop, has a capacity of 600 electrical horse-power. These transmission lines are wooden-pole structures, being 30 feet high and 175 feet span.

There are also two 12,000 volt, wooden-pole lines running from the distributing station to the international boundary, a distance of 6 miles. The conductors of this circuit are 70,000 circular mils aluminum, which is equivalent to No. 4 copper. The nominal capacity is 600 electrical horse-power. They are intended to supply current for manufacturing interests in Niagara Falls, Ontario, and also for some American delivery at 12,000 volts.

All of these pole lines for part of their distances are constructed on the public highways. There are now installed two 60,000-volt individual steel-tower transmission lines from the distributing station to the international boundary, a distance of 6 miles.

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The conductors of these lines are 820,000 circular mils aluminum, which is equivalent to 500,000 circular mils copper. Each 3-phase circuit has a nominal capacity at the assumed economic drop of 35,000 horse-power.

This line is constructed on individual steel triangular cross-section towers 40 feet in height, with 550 feet span. The conductors are placed so that they form an equilateral triangular cross-section with the apex of the triangle above. The wires are 7 feet apart, and lines are 26 feet 8 inches, centre to centre. These lines are constructed on a private right of way 300 feet wide.

At the Canadian bank of the Niagara river there is a set of high-tension bus bars arranged on poles in the open. Immediately beyond these are installed 3 cantilever structures anchored to the solid rock of the bank, over which structures, the 3-phase circuits are carried to standard steel towers set in concrete on the edge of the river bank below. From these standard towers the circuits are carried to the American side to a similar construction, the wires being approximately 60 feet above the level of the river. Three crossings have been installed.

APPENDIX D.

THE LINES OF THE NIAGARA, LOCKPORT AND ONTARIO POWER COMPANY.

From the 3 cantilever structures on the American bank of the Niagara river at the crossing point this company takes the current through a system of bus bars to the switching station. This station at present is under construction, the building only being completed. Between the cantilever terminals and the switching house are installed complete 'Horn' lightning arrester equipments.

From the switching station to the Lockport substation, a distance of 16.76 miles, there are constructed two steel-tower transmission lines on a right of way 300 feet wide. This transmission line consists of individual triangular steel towers, each carrying a 3-phase circuit whose conductors are 642,000 circular mils aluminum, having a nominal capacity of 30,000 horse-power with the assumed economic drop.

At Lockport there is a switching and transforming station for the Lockport service. This station has installed three 750-kilowatt transformers, or a total of 3,000 electrical horse-power. The building is constructed for twice this capacity, or 6,000 electrical horse-power.

At this point in the line, a branch line for the Lackawanna Steel Company is taken off. There are being built two 3-phase circuits on a right of way 100 feet wide. The total length of the line is 27 miles. The conductors are 642,000 circular mils aluminum cables, with a nominal capacity of 30,000 horse-power per 3-phase circuit. This transmission line is constructed on A-frame individual steel towers 40 feet in height, with a span of 550 feet. The towers are about 60 per cent installed, while the work of installing the cables was being commenced at the Lockport end.

The Syracuse system does not enter the switch or terminal station at Lockport, but continues on a 200-foot right of way, there being two steel-tower lines constructed at the present time. This tower construction is similar to the construction from the switching station at the international boundary to Lockport. Each pole line carries three 428,000 circular mils aluminum cables, with a nominal capacity of 20,000 horse-power. This section of the line runs 11.1 miles east of the Lockport substation, at which point (C) it branches into two separate lines on separate rights of way. From point C to Mortimer, a distance of 45½ miles, there is one steel-tower transmission line constructed on a private right of way 200 feet in width, the line being composed of three 428,000 circular mils aluminum cables. From point C there is also a single steel tower line on a 20-foot right of way, to the right of way of the West Shore Railroad, a distance of 9.34 miles, and continuing on the right of way of the West Shore Railroad to Churchville, a distance of 25.4 miles. From point C to Churchville this

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line is single steel-tower construction carrying three 428,000 circular mils aluminum cables. At Churchville the line crosses the West Shore Railroad and continues on a 50-foot right of way to Mortimer, a distance of 11.25 miles. On this right of way there are two lines under construction, both carrying 428,000 circular mils cables. At Mortimer is intended to be a junction of the main line to the West Shore division line.

From Mortimer to the crossing of the New York Central Railroad, 7.2 miles east of Mortimer, the wooden-pole line carrying 428,000 circular mils cables is continued. At this point the size of the cable falls to 214,000 circular mils aluminum, with a nominal capacity of 10,000 horse-power. From Fairport this line is continued with the same size cable on the right of way of the West Shore Railroad to Syracuse, a distance of 67.95 miles. From Fairport there is intended to be constructed a main line on a right of way somewhat south of the West Shore Railroad. This line will be a one steel-tower line of 428,000 circular mils, to be constructed on a 75-foot right of way 76 miles in length. The right of way is being secured at the present time. This will join the West Shore line at a point just outside the city limits of Syracuse.

It is the practice of this company to place their transmission lines upon the right of way 26½ feet from centre to centre, beginning 10 feet from one edge of the right of way. Throughout the approved right of way they have constructed a patrol road and telephone lines, except on some branch lines and on the West Shore Railroad.

THE BRANCH LINES.

There are under construction branch lines from the switching station to Niagara University over an easement right of way a distance of four-tenths of a mile; from the Lackawanna line to Depew over an easement right of way 5 miles in length; from Oakfield to Batavia over an easement right of way 8.6 miles in length; from Mortimer to Geneseo over a private right of way 20 feet wide, the line from Mortimer to Geneseo being 13.4 miles in length and the second branch, to Caledonia, 5.8 miles in length; from Weedsport to Auburn over a 20-foot private right of way 6.5 miles long; and from near Warner to Baldwinsville over a 20-foot private right of way a line 4.6 miles in length.

All of these lines are to be single 3-phase circuits, of No. 4 B. & S. copper conductors, erected on wooden poles. The nominal capacity of these lines at 60,000 volts with the assumed economic drop, is estimated to be 3,000 electrical horse-power each.

APPENDIX E.

THE WORKS OF THE ELECTRICAL DEVELOPMENT COMPANY OF ONTARIO.

The water is diverted for this development at Tempest Point, midway between the headworks of the Ontario Power Company and the Canadian Niagara Power Company. The general design is a gathering dam to gather the water from the rapids; two fore bays the entire length of the power-house, the inner one of which is under the power-house structure; a wheel pit containing vertical Francis turbines; two tail-race tunnels, joining into the main tail-race tunnel which discharges under the Horseshoe Falls.

THE HEADWORKS.

The gathering dam is 785 feet long and its maximum height is 27 feet. It is expected that 3 to 8 feet of water will be flowing over it, depending upon the condition of the river. Adjacent to the power-house the dam is cut away 3 feet below the level of the main crest for a length of 30 feet, so that there will be 3 feet additional depth of water to carry away the ice from in front of the power-house.

The outer fore bay has for its outer wall submerged arches. At the north end of this fore bay is a spillway for the ice and floating materials that pass through the sub-

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merged arch curtain wall, to be returned to the river above the falls. In addition to the first line of submerged arches just referred to, a second submerged arch curtain wall has been constructed outside of the racks. This inner fore bay is covered by the main power-house structure. At the north end of this fore bay is a spillway similar in construction and purpose to the one for the outer fore bay. The fore bays and gathering wall are completed for the entire installation. It was expected that water would be turned into the fore bays during the first week of August.

THE SCREEN HOUSE.

The screen house, which is under the main power-house roof, extends the entire length of the building. It is equipped with a travelling crane for handling the screens which set on inclined guides in concrete masonry. Immediately in the rear of these racks are the cast-iron bell mouths, which in turn join to riveted steel penstocks 10 feet 6 inches in diameter, one for each turbine. At the head of each penstock is a vertical electrically operated gate to control the water.

The masonry for this inner fore bay and screen house is complete for the entire installation.

THE WHEEL PIT.

The wheel pit is 416 feet long and 22 feet in width inside of the brick lining, which is 2 feet thick. It is spanned by masonry arches at 3 levels to carry the machinery. Both ends of the pit are also closed by arched wall linings.

TAIL-RACE TUNNELS.

There are two side tunnels, one on each side of the wheel pit, one for 5 units and one for 6 units. They come together 150 feet north of the wheel pit and merge into the main tunnel. The 5-unit tunnel is 514 feet long, and the 6-unit tunnel is 524 feet long, which lengths are measured from the end of each tunnel to the junction with the main tunnel. These tunnels are each 25 feet deep, of horseshoe cross section, and vary in width from 66 to 30 feet. At the junction the tunnel is 35 feet wide and 25 feet 6 inches high, and tapers to a width of 23 feet 5 inches and a height of 27 feet, which section is carried to the edge of the falls, a distance of 1,935 feet. The slope of this main tail-race tunnel is 5.5 feet per 1,000. The velocity of flow is estimated to be about 26 feet per second. The tunnel has a lining 2 feet thick throughout of concrete faced with brick, except for 300 feet at the north end where the lining consists of concrete rings in 6-foot sections, which are expected to break off as the falls gradually wear away.

TURBINES.

There will ultimately be 11 twin vertical Francis internal-discharge turbines, 54 inches in diameter. Their nominal rating is 12,500 horse-power, running at 250 revolutions per minute.

There is a single cast-iron draft tube 9 feet in diameter for each wheel and they discharge alternately underneath the east and west tail-race tunnels. The object of this under discharge is to seal the draft tubes, preventing loss of vacuum, without the necessity for a tail-race weir. By using the two tunnels it is possible to shut off the water entirely from one-half of the wheels without interfering with the other half. A gate has been provided at the end of each tunnel, in case there should be extreme back water in the main tunnel. The wheel pit is not connected to the tail-race, and therefore the hydraulic apparatus can never be flooded out.

There are now being installed 4 turbine units. The turbines are furnished by the I. P. Morris Company, of Philadelphia.

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GENERATORS.

The power of the water wheels is delivered to the electrical generators, which are on the ground floor, through vertical shafts 150 feet long, consisting of riveted steel tubes 30 inches in diameter between bearings, and solid shaft 14½ inches in diameter at the bearings. This shaft is held by guide bearings resting on concrete arches. The deck immediately below the generators carries a thrust bearing 37½ inches in diameter, fed by oil under pressure of 350 pounds per square inch. This bearing is sufficient to carry the weight of the entire revolving parts in case of failure from any cause of the water-thrust bearing in the turbine.

There will be eleven 8,000 kilowatt generators of the internal revolving field type, revolving at 250 revolutions per minute. They deliver three-phase alternating current at a periodicity of 25 cycles and potential of 12,000 volts. There are now being installed by the makers, the Canadian General Electric Company, four of these generators.

EXCITER PLANT.

The plan for the exciter installation of this plant is for 2 turbine-driven and 2 motor-driven exciters. The turbine-driven generators are of 300 kilowatts each, giving direct current at 125 volts. The turbines for the two exciters are installed complete. One of the exciter generators is on the ground and the other is being shipped from Peterborough, Ontario. The turbines are built by the I. P. Morris Company, and the generators by the Canadian General Electric Company. Any two of these exciters, either motor or turbine-driven, will excite the entire plant of 11 units.

SWITCH BOARD.

The control switch board for the entire plant, including transformers and transmission lines, is located in the centre of the power-house where the operator can see the entire installation. It consists of an inclosed compartment with a bench board in front. The indicating instruments are on the face of the board, while the recording instruments are on the back. The board is of black enamelled slate, and together with the instruments, is made by the Canadian General Electric Company. Dummy bus bars and signal lamps on the bench board clearly indicate to the operator the connections in the station, and the instruments are so located that each is over the switch that controls it.

The slate of the entire switch board is installed for the entire 11 units. Instruments, switches, &c., for the 4 units and the exciters are on the ground and are nearly installed. The oil switches and their wiring are installed for 2 units, ready for service, and the installation for the other two is being pushed. All the parts of the switches and of the wiring are on the ground and are waiting for the completion of the concrete work before they are installed. The power-house bus bars and generating oil switches, voltage, and current transformers are located immediately below the power-house floor in brick compartments.

POWER-HOUSE STRUCTURE.

The power-house is built of steel and cut stone. It is to be about 500 feet long and 70 feet wide. The height will be 40 feet, except at the centre and end faces. The central bay will give room for the offices of the power company as well as the main entrance, which bay will stand out from the face of the building. This bay will also afford space for the switch-board and auxiliary apparatus.

The contract for the steel and stonework is for two-thirds of the main building, which contract is approximately 50 per cent completed. The steel work is entirely completed at the present time for two-thirds of the building, while the stonework is about 50 per cent completed.

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UNDERGROUND CABLE SYSTEM.

The power-house is connected by 4 underground conduits to the transformer house, which is situated upon the hill back from the river, and the buildings are 1,817 feet apart. The design calls for 4 underground conduits, one of which will be in reserve, so that the plant will not be crippled unless 2 conduits simultaneously fail.

At present 2 conduits only are being constructed, each with 16 $4\frac{1}{2}$ -inch ducts placed 2 wide and 8 deep. The manholes are common to the 2 conduits and are divided into two parts by a central partition, so that one duct system will not be damaged by the burning out of the other. These two conduits are completed except for the crossing of the Ontario Power Company's pipe line, and that will be completed by August 15. At the present time the cable for construction of the four machines is about 75 per cent completed, while all of the cables for these four machines are on the ground.

TRANSFORMER HOUSE.

The transformer house is on top of the bluff outside of the Queen Victoria Niagara Falls Park limits, and is designed to accommodate fifteen 2,670 kilowatt single-phase transformers. These transformers are of the oil insulated water-cooled type, and are wound for 10,000, 11,000 and 12,000 volts primary, and 40,000, 50,000 and 60,000 volts secondary. They will be connected in delta on both primary and secondary windings. The transformer building is completed for the installation of 5 units or 62,500 horse-power.

There is on the ground 1 bank of three transformers, which are being installed; a second bank of three will be shipped by August 1, and the third bank about August 15, from the makers, the Canadian General Electric Company, of Peterborough, Ontario. It is estimated that the electrical installation of this transformer house is about 43 per cent completed at the present time.

Each transformer is placed in a separate closed fire-proof compartment, so as to minimize the fire risk and prevent the possibility of trouble in one transformer being communicated to others. The transformers are mounted on rails arranged to slide out of the compartments into the gangway, where they can be readily handled by an overhead travelling crane. Piping for oil and water for the transformers is in the basement of the building and in the hall of the transformer compartments.

APPENDIX F.

TORONTO-NIAGARA POWER COMPANY.

This company, which transmits the power developed by the Electrical Development Company to Toronto, is constructing a transmission line on right of way 80 feet wide from the transformer house above mentioned to Toronto.

The design is for two steel-tower transmission lines, each tower line carrying two 3-phase circuits of 190,000 circular mils copper conductor. These two lines are to be built so that an interurban double-track electric railway can be built between them on the same right of way. The standard distance between poles is 400 feet, there being, however, much longer distances at river and ravine crossings. The height of the standard tower, which is of the A form, is 40 feet above the ground.

There is at present being constructed one of the transmission lines with a capacity of 20,000 electrical horse-power, each 3-phase circuit being designed to carry one-half the load, or 10,000 electrical horse-power. The loss of power when each line is transmitting its full load of 10,000 horse-power will be less than 10 per cent, while either line can transmit 20,000 horse-power with less than 20 per cent loss.

This transmission line between the transformer house and Toronto is about 90 per cent completed. It is completed from the Niagara end to Burlington Beach and from the Toronto end to Burlington Beach. There are about three division houses

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along the line, dividing it into four sections, any one of which can be cut out for inspection and repair. A lineman will patrol each section daily after the transmission line is in operation.

APPENDIX G.

THE WORKS OF THE CANADIAN NIAGARA POWER COMPANY.

The general design of this company is an ice rack on the shore line; a short canal which widens into an outer fore bay the entire length of the power-house; an inner fore bay, screen frames, and penstock gates, all of which are located in a low bay adjacent to the east side of the main power-house structure (the outer wall of this bay being a submerged arch curtain wall); a sluiceway at the north end of the inner fore bay for leading the waste water and ice back to the river above the falls; a wheel pit capable of containing eleven 11,000-horse-power vertical twin turbines, which are directly connected to alternators of the same capacity on the main floor by means of hollow shafting and thrust bearings; a Queenston limestone power-house to cover the wheel pit and house the generators and controlling apparatus, and lastly a tail-race tunnel—horseshoe cross section—which leads the water from the turbines to the lower river.

HEADWORKS.

The power-house is built parallel to the river and about 400 feet from its bank. The water is taken from the river into an outer fore bay through the ice racks and a canal 282 feet in width and 15 feet in depth. The ice rack is constructed on cut-stone piers, eleven in number, on the shore line. It is made of steel rods set at an angle of about 30° from the horizontal. Ninety-two feet back from the ice rack is the five-span stone-arch bridge which carries the tracks of the Niagara Falls Park and River Railway, the carriage road, and sidewalk. Immediately after passing under this bridge, which is 73 feet in width, the canal widens into a fore bay 600 feet wide, which extends the entire length of the power-house. The headworks are built of massive limestone masonry.

The inner fore bay, screens, and penstock gates are in a low bay adjacent and joining the main power-house structure on its entire east side. The outer wall of this structure is a submerged arch curtain wall, there being two arches for each penstock. The structure, equipment, and masonry of this bay is complete for 5 units, while the masonry of the curtain wall, screen racks, and penstock mouths is also complete for the other 6 units. At the north end of the inner fore bay is an overflow weir which can be used in combination with floating booms to draw floating materials and ice that get into this fore bay back into the river above the falls by means of a sluiceway channel. This channel is 16 feet wide and 300 feet long.

WHEEL PIT.

The wheel pit is 165 feet deep, 18 feet wide inside of the brick lining and 570 feet long. The sides were channeled in 6-foot cuts. There are five chambers for auxiliary machinery excavated in the east side of the wheel pit. The three in the portion of the wheel pit that is used at present are occupied as follows: No. 1. By the three exciter units; No. 2. By the circulating water pumps, for pumping the water that is used for cooling purposes in the transformer house; No. 3. For the oil pumping apparatus. A regulating gate is installed at the end of the wheel pit to maintain the level of the tail water at a sufficient height at all loads to cover the mouths of the draft tubes.

THE TUNNEL.

The tunnel which leads the water from the wheel pit to the lower river is 2,200 feet long and of a horseshoe cross section, 25 feet high and 19 feet wide, being lined

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with 17 inches of concrete with vitrified brick facing, except for 100 feet at the river end, where the tunnel drops by an ogee curve into the river. This portion is lined with 2 feet of granite, and a massive head wall 60 feet long by 12 feet thick extends from 20 feet below the bottom of the tunnel to 10 feet above it, making a total height of 55 feet, of which 34 is below normal water level. The grade of this tunnel is 7 feet per thousand, which will give the water a velocity when the plant is in full operation of about 27 feet per second. The tunnel is excavated through limestone rock and black shale.

The hydraulic portion of the development of this company, with the exception of the turbines for the remaining six units, is complete for the development of 110,000 electrical horse-power.

POWER-HOUSE.

The power-house structure, as built at present, is complete for five units. It is a one-story structure built of Queenston limestone and roofed with tile. The inner fore bay and screen house are covered by an addition which is supplementary to the main power-house. The building is lined inside with mottled buff brick, enamelled brick, and marble. The main power-house has installed two 50-ton electric cranes for service in the installation of machinery.

HYDRAULIC MACHINERY.

The entire development calls for eleven 11,000-horse-power vertical twin Francis inward-flow turbines. There are five installed. These machines were designed by Messrs. Escher, Wyss & Co., of Zurich, Switzerland. The first three were manufactured and installed by this firm, while the latter two are of the same design but were built and installed by the I. P. Morris Company, of Philadelphia, Pa.

The water is led to each turbine by means of a single vertical penstock 10.2 feet in diameter, the mouth of which is laid in the inner fore bay behind the screens. Each penstock has its individual electrically operated gate. The water is discharged from the turbines into two draft tubes, one on each side of the pit and discharging into the open tail-race below. The effective head at full load is stated to be 141 feet.

GENERATORS.

The generators are the internal revolving field type, and have a nominal capacity of 8,250 kilowatt. They are designed to run at 250 revolutions per minute, giving 25 cycle, 3-phase current at 12,000 volts. The generators have an efficiency at full load of about 98 per cent and a regulation on full noninductive load of about 8 per cent. The armatures are connected Y, and the neutral is brought out so that it can be grounded if desired. The generators were built and installed by the General Electric Company, of Schenectady, N.Y.

SWITCH BOARD.

From the generators the current is led through varnished cambric, insulated cables to double-throw selector oil switches and thence to the bus bars, of which there are four sets. The switch board consists at present of 5 generator panels, 20 feeder panels, 10 recording wattmeter panels, and 3 bus bar interconnecting panels. It is seen from this that each panel is distinct and contains no instruments or switches except those belonging to the particular feeder or generator in question.

The present equipment of the power-house comprises 5 units, and this group and its switch board is considered as a complete plant. The other 6 units are to have an entirely separate switch board, separate exciter plant, and in fact will be a separate plant in itself. This separation is made for the reason that 50,000 horse-power is

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believed to be as large a block of power as should be under the control of a single switch board and its attendant.

EXCITER PLANT.

The exciter plant is located in a compartment near the bottom of the wheel deck at the turbine deck level. There are three 200 kilowatt, 125 volt D. C. generators, each connected to an independent vertical turbine. Any two of these units will carry the entire direct current load of the plant as at present installed. These exciters are developing at the present time about 200 horse-power, which is used for the excitation of generators and the operation of auxiliary apparatus around the plant. They are, therefore, using about 17 cubic feet of water per second. There are two sets of exciter bus bars, one of which operates the generator fields and the other the D. C. power system, including motors and arc lights. The current is carried up the pit to the main floor of the power-house through a system of vertical copper bars supported every 10 feet.

UNDERGROUND-CABLE SYSTEM.

All the power from the power-house is transmitted underground by means of No. 000 B. & S. paper-insulated, 3-conductor, 12,000-volt, lead-covered copper cables. The feeders are divided into two groups. One set leads from the north end of the power-house through Victoria Park and across the upper steel-arch bridge to the plants of the Niagara Falls Power Company, with which they are interconnected. The other group runs south, up the high bank above the power-house, to the transformer-house there located.

There are installed at present 8 underground cables for transmitting power to the United States by way of the upper steel-arch bridge. Each of these cables has a capacity of 4,000 electrical horse-power, making a total cable capacity at present for transmission of power into the United States of 32,000 horse-power. There are conduits laid between the Canadian and American plants, which conduits cross the river at the upper steel-arch bridge and which are designed to contain 32 cables like those already installed, making an aggregate conduit capacity by way of the upper steel-arch bridge of 128,000 horse-power.

There are conduits laid between the power-house and the step-up transformer house, which conduits are capable of containing 32 cables with a total carrying capacity of 128,000 electrical horse-power. It is seen that there is conduit capacity from both ends of the station capable of carrying the entire output of the station if necessary.

TRANSFORMER HOUSE.

The transformer house, which is located on the cliff southwest of the power-house, is constructed for a present capacity of 25,000 horse-power. The building is divided into three sections. The east bay contains all the 12,000-volt switches and bus bars, the central bay contains the step-up transformers only, and the west bay the high-tension switching apparatus. The transformers are of the oil-insulated type, water cooled. The water for cooling purposes will be supplied, normally, from the pumps located in the water-pumping chamber of the wheel pit. There is also installed a stand pipe, 116 feet high by 30 feet in diameter, carrying one day's supply of water to be drawn upon in case of an accident to this pumping system.

There are installed at present twelve 1,250-kilowatt step-up transformers, with a total capacity of 15,000 kilowatts. There are also four step-down transformers of 250-kilowatt capacity each, having a total capacity of 1,000 kilowatts. The former transformers have a voltage ratio of 12,000 to 24,000 or 36,000, or 41,500, or 62,600 volts. The 250-kilowatt step-down transformers have a ratio of 11,000 to 2,200 volts. The latter are used for supplying the local distributing service in Canada. There is space available for three more 1,250-kilowatt step-up transformers, making the total

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capacity for transmission purposes at 24,000 volts, 25,000 horse-power. This 'step-up' transformer equipment is designed for supplying current to the Fort Erie-Buffalo transmission line at 24,000 volts pressure.

TRANSMISSION LINES.

There are now installed in Canada a 2,200-volt overhead line for local distribution, consisting of a pole line aggregating about 4 miles in length and containing two 3-phase circuits; eight underground cables for transmitting power into the United States by way of the upper steel-arch bridge, and one 24,000-volt 25,000 electrical horse-power transmission line to Buffalo, which line is now being built by way of Fort Erie, and will be ready for service about September 15.

This transmission line will consist of two lines of iron-anchored poles, 40 feet high, spaced 300 feet apart, and will carry two 3-phase aluminum circuits, each conductor of which is a 37-strand cable having a cross section of 500,000 circular mils. These lines are built on a private right of way, 30 feet wide, extending from the transformer house to the river front at Fort Erie. The ultimate capacity of this line is 50,000 horse-power, which will be carried on two pole lines on this 30-foot right of way, each line carrying two circuits, each circuit having a nominal capacity of 12,500 horse-power at 24,000 volts. The estimated loss in transmission is about 7 per cent. The line is 16 miles in length.

The poles consist of two 4-inch wrought-iron pipes joined together at the centre by a casting which has four struts, 90° apart, projecting radially. Truss rods secured at the top and bottom of the poles pass over the ends of these struts, and when tightened up stiffen the jointed pipe. The function of this central tubular member is to resist downward compression only. The horizontal stresses on the pole are resisted by four guy rods anchored in the ground with concrete guy stubs, one of these guys being in each quadrant around the pole. Under the central member of the pole is placed a heavy block of concrete which carries the iron step for the central pipe and takes the thrust.

The insulators are made of a compound known as 'electrose.'

At Fort Erie the line is tapped by a connection to a local substation for the supply of power to that municipality. The line then rises from the standard 40-foot elevation to a tower 80 feet high, erected about 1,200 feet from the Canadian shore line of the Niagara river. Thence the line rises again by a single span of 1,200 feet to a tower 210 feet in height on the river bank; thence by another single span of 2,300 feet the line passes to the Buffalo side of the river to another 210-foot tower. From there it drops down to a new 50,000-horse-power terminal house constructed for the distribution of this power in Buffalo. The tension is held the same at all conditions of wind and weather by means of strain insulators and heavy weights at both ends of the span.

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OTTAWA, May 20, 1907.

A. GOBEIL, Esq.,
Deputy Minister of Public Works,
Ottawa, Ont.

DEAR SIR,—I beg to transmit to you herewith all reports issued by the International Waterways Commission, as well as the separate reports of the American and Canadian sections up to May 1, 1907.

Since the last annual report of the Canadian section has been filed with the Honourable the Minister of Public Works, the commission has dealt with the question of determining the boundary line on Lake Erie ; the question of the Chicago drainage canal, and the application of Mr. Smith L. Dawley, of Ogdensburg, N.Y., for permission to construct at Long Sault Island, in the township of Massena, St. Lawrence county, N.Y., dykes, retaining walls and such other structures as might be necessary to create an attractive summer resort with navigable approaches thereto and the development of a water-power.

The reports of the commission upon the Lake Erie matter and upon the Chicago drainage canal are published.

As to the application of Mr. Smith L. Dawley, the commission has disposed of it, at a meeting held in Toronto on January 4, 1907, by adopting the following resolution :—

‘Whereas, Mr. Smith L. Dawley, of Ogdensburg, N.Y., submitted to the Honourable Secretary of War of the United States, under date of May 28, 1906, an application for permission to construct at Long Sault Island, in the township of Massena, St. Lawrence county, N.Y., dykes, retaining walls and such other structures as might be necessary to create an attractive summer resort with navigable approaches thereto, and the development of a water-power entirely in that portion of the St. Lawrence river that is within the United States, which application was referred to the International Waterways Commission by endorsement of the Secretary of War, dated June 2, 1906; and,

‘Whereas, the application did not furnish information sufficient to justify a recommendation in the matter, and the efforts of the commission to obtain such information from Mr. Dawley have thus far been without success ;

‘Whereas, the commission now learns that Mr. Dawley has transferred his rights at Long Sault Island to the Pittsburg Reduction Company, and it is the opinion of the commission that if any permit for the construction of works at this place is to be granted, it should be dealt with upon a direct application from the beneficiary ; therefore be it

‘Resolved, That the International Waterways Commission recommend to the Honourable Secretary of War of the United States, that the application of Mr. Smith L. Dawley be denied.’

The commission is now engaged in investigating the proposed construction of controlling works at the outlet of Lake Erie. The subject has been referred to the hydraulic engineers of the commission, Messrs. Louis Coste and E. E. Haskell, and it is expected that a report will be submitted at an early date.

The commission has also under consideration an application from the Pittsburg Reduction Company, which asks authority to construct dams, canals, power stations and locks for the improvement of navigation and development of water-power at and near Long Sault Island, St. Lawrence county, N.Y. This application is not the same as the one made by Mr. Smith L. Dawley ; but it is admitted that all the chartered rights of Mr. Dawley have been transferred to or acquired by the Pittsburg Reduction

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Company. The detailed plans of the undertaking have not as yet been submitted to the commission.

His Excellency the Governor General in Council has recently referred the following questions to the commission :—

1. The construction of a dam at the foot of Long Sault rapids in order to improve the navigation of the Rainy river ;
2. The application of the Grand Falls Power Company for permission to erect hydraulic works on the St. John river, N.B. ;
3. The matter of preventing damages caused to riparian owners by the overflowing of its banks by the Richelieu river.

These questions will be taken up by the commission at an early date.

Since the issue of the last annual report, which was presented to parliament in January last, the Canadian section has held several meetings in Toronto and in Ottawa.

Dr. W. F. King, who was one of the Canadian commissioners, resigned in March last, and was succeeded by Mr. W. J. Stewart, the Dominion Hydrographer, who took his seat on the commission, for the first time, at a meeting held in Buffalo on April 18.

I have the honour to be, sir,

Yours very truly,

THOMAS COTE,

Secretary, Canadian Section.

